

MORPHOLOGICAL AND BIOLOGICAL NOTES ON  
SOME SOUTH AFRICAN ARTHROPODS  
ASSOCIATED WITH DECAYING ORGANIC MATTER

PART 2

THE PREDATORY FAMILIES CARABIDAE,  
HYDROPHILIDAE, HISTERIDAE, STAPHYLINIDAE AND  
SILPHIDAE (COLEOPTERA)

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(With 16 figures)

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ABSTRACT

The morphology of the immature stages of fourteen species of beetles belonging to the families Carabidae, Hydrophilidae, Histeridae, Staphylinidae, and Silphidae, as collected along a narrow strip between Mossel Bay and Elands Bay and in a small area around Laingsburg and Tulbagh, is illustrated. Available data on their biology and ecology are given and their association with decaying organic matter is noted. These insects play an important part in the predation of the arthropods attracted to carcasses and cadavers and other decaying organic matter.

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## INTRODUCTION

In the first part of this series of papers some specimens belonging to the myriapods, arachnids, crustaceans, and hemimetabolous hexapods are dealt with; in this second part the immature stages of the first group of the holometabolous families are considered.

This group comprises one species of the adepagous Coleoptera and thirteen species of the polyphagous series Staphyliniformia, which includes the superfamilies Hydrophiloidea, Histeroidea, and Staphylinioidea.

The surveys covered the beach, the dune system and the adjacent inland area along a narrow strip of the southern and western coastal regions of South Africa; a small strip between Laingsburg and Beaufort West, as well as between Worcester and Tulbagh, was also included.

Nearly half of all known insects are beetles and, although they are of such diverse form and habits and include some of the largest and also some of the smallest of insects, only a very few of them have developed a tendency to sociality. Of the some 150 known families only about nine show some signs of sub-social behaviour and these include the Staphylinidae, Silphidae, Hydrophilidae, and also the Scarabaeidae. However, none of the South African species or, at least, those that have been collected during the surveys, can be regarded as sub-social, except perhaps hydrophilids belonging to the genus *Spercheus*; some may well be described as gregarious as in the case of *Harpalus capicola* Dejean and *H. agilis* Péringuey (Carabidae); *Gonocephalum arenarium* (Fabricius), *G. simplex* (Fabricius), *Zophosis boei* Solier, and *Stenocara longipes* (Olivier) (Tenebrionidae), and various other species often collected in very large numbers under semi-dry to dry cow-pats, such as the vegetable weevil, *Listroderes costirostris* Schönherr (Curculionidae).

All the species discussed in this paper are geophiles and all are predacious both in the adult and larval stage, except the hydrophilids, the adults of which are coprophages. All are attracted to decaying organic matter in which other arthropods are breeding, and therefore play an important part in reducing the number of coprophagous species. Nevertheless, they will feed on the colloids oozing from the decaying matter if circumstances necessitate this, particularly the hydrophilids and silphids and, to a certain extent, the staphylinids.

The larvae of most species are campodeiform, and in the case of the Sphaeridiinae the legs are reduced and they resemble the scarabaeoid forms.

As the amount of food available plays an important part in the development of these insects, and as this food source is often limited, dwarfed individuals are common in nature, sometimes differing markedly from the normal forms. This is clearly demonstrated by some specimens of an unidentified species of *Philonthus* (Fig. 1B) collected in various localities during the survey and included here in the discussion on the Staphylinidae. To the naked eye the adults appeared to be two different species; however, there were no morphological

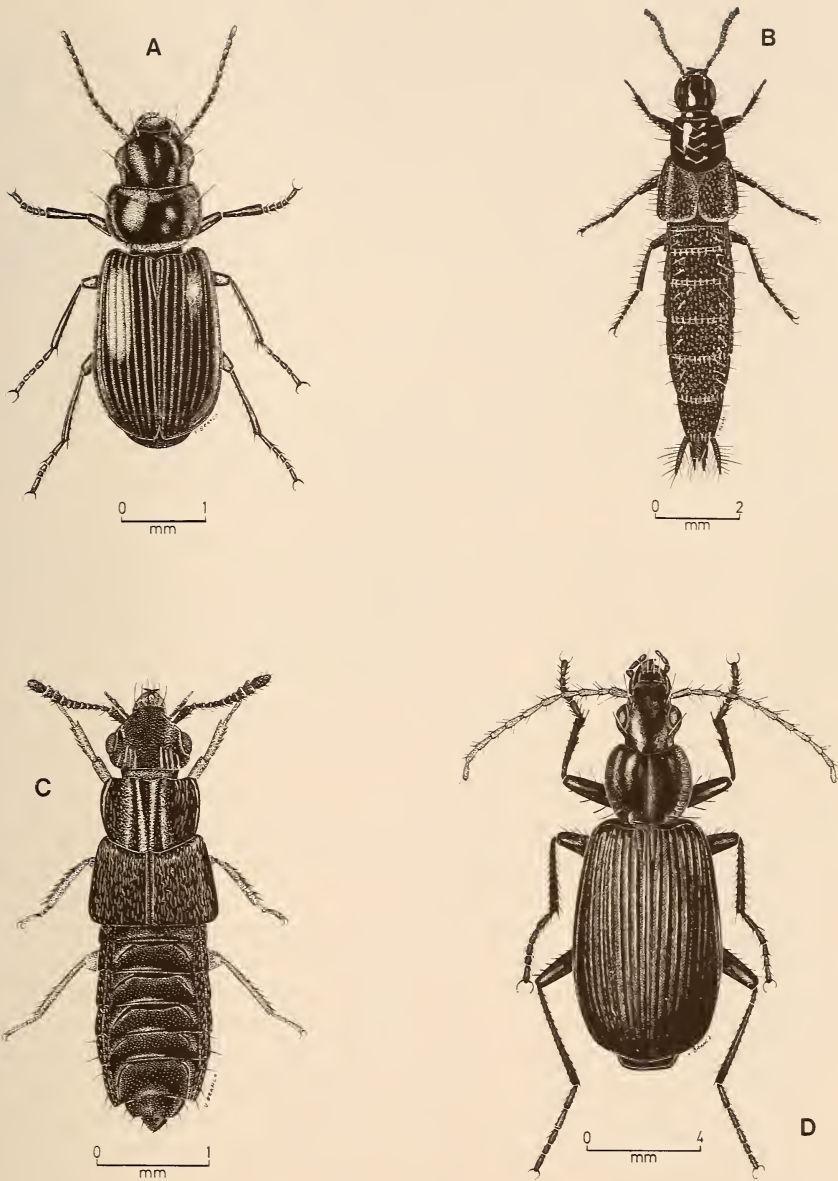


Fig. 1. Families Carabidae, Staphylinidae.  
 A. *Amblystomus capensis* (adult). B. *Philonthus* sp. (adult). C. *Oxytelus caffer* (adult).  
 D. *Liamegalonychus* sp. (adult).

differences when the larvae were examined under the microscope and it is therefore assumed that they are variants of the same species.

The morphological terms used in this paper in the descriptions of the immature stages are those of Richmond (1920), Böving & Craighead (1931), Hafez (1939a-d), Dorsey (1940), Van Emden (1942), and Kasule (1968).

## MORPHOLOGICAL AND BIOLOGICAL NOTES

### Family Carabidae

Flat to oval, usually dark-coloured beetles with the thorax generally narrower than the elytra, except in certain groups such as the tribe Scaritini. Head narrower than pronotum and tarsi five-segmented. Antennae eleven-segmented. Wings well developed or absent.

The ground beetles can be divided into species that live near or in water, on the ground and in trees; of these groups the geophiles are the most abundant, the vast majority of which belongs to the subfamilies Carabinae and Harpalinae. The eggs of the different species are laid either in the soil or in little mud packets and there are three larval stages. Pupation usually occurs in the soil in a pupal cell.

Certain species are commonly found under kelp strings and flakes just above the highwater mark, such as the black *Acanthoscelis ruficornis* (Fabricius) (Fig. 2B), which was on various occasions excavated from the burrows of the isopod *Tylos capensis* Krauss and was also observed to feed on beach-fleas (*Orchestia* and *Talorchestia* spp.), fly maggots, and even on the ladybird *Lioadalia flavomaculata* de Geer, which is often found on the kelp. It was now and then collected from dead sea-birds. When feeding, the prey is held between the forelegs, and in the case of maggots almost everything is consumed except the mouth-hooks and a few pieces of the skin. Its food included the smaller, pale, straw-coloured cicindelid, *Platychila pallida* (Fabricius) (Fig. 2G), which occurred under similar conditions. This tiger beetle seems to favour the more arid parts of the north-western Cape Province.

*Scarites rugosus* Wiedemann (Fig. 2A) closely resembles *A. ruficornis*, but is much larger (30 mm) and has a wider distribution in South Africa, both along the coast and inland. Péringuey's (1896) note that it is generally found on the sea-shore, or at no great distance inland, is therefore not entirely correct. It was often found in the sand under shore plants; otherwise its habits are unknown.

Various other carabids have been collected in decaying and dry kelp, mostly of the flake and string types, of which *Harpalodes xanthorhaphus* (Wiedemann), *Harpalus fuscoaeneus* Dejean, *Tetragonoderus immaculatus* LaFerté, *Agonum rufipes* (Dejean), and *Liamegalonychus* spp. (Fig. 1D) were the most common. The first two species are widely distributed in South Africa and, together with *Liamegalonychus* (which also feeds on the flesh-fly *Sarcophaga maritima* Engel) have often been collected under cow-pats. *Hystrichopus vigilans* (Sturm), which resembles *Liamegalonychus* spp. and sometimes occurs in manure in the western Cape Province, has been found by the author to cause mild



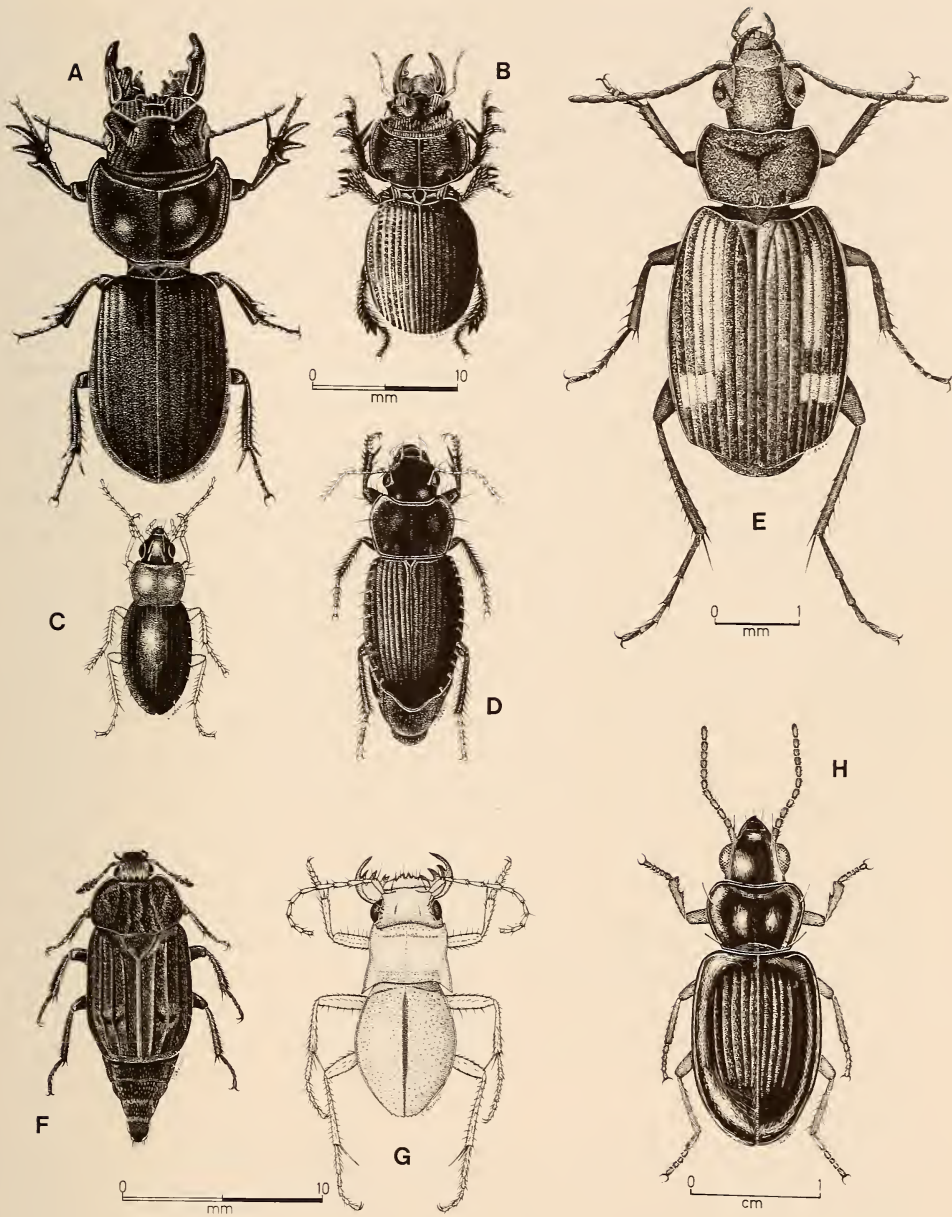


Fig. 2. Families Carabidae, Cicindelidae, Silphidae.

A. *Scarites rugosus* (adult). B. *Acanthoscelis ruficornis* (adult). C. *Geobaenus lateralis* (adult). D. *Harpalus capicola* (adult). E. *Tetragonoderus thunbergi* (adult). F. *Silpha mutilata* (adult). G. *Platychila pallida* (adult). H. *Thachys capicola* (adult).

irritation of the skin in hypersensitive people when carelessly handled. All these species are black, except the first named, which is brown. *Agonum rufipes* has light-reddish legs.

*Tetragonoderus immaculatus* is rather similar to *T. thunbergi* (Crotch) (Fig. 2E), which occurred together with *Harpalus agilis* Péringuey and *H. fuscoaeenus* in soils rich in organic matter such as fish-meal and compost, but it is somewhat bigger and lacks the two pale-yellowish patches on the apical parts of the elytra.

At least twelve carabids were collected under dry cow-pats, the largest being the previously mentioned *Liamegalonychus* sp. (14–15 mm). *Harpalomorphus capicola* Péringuey, *Harpalus capicola* Dejean (Fig. 2D), *H. agilis* Péringuey, *H. fulvicornis* Thunberg, *H. fuscoaeenus* Dejean, and *Cratognathus mandibularis* Dejean are all medium-sized species (7–12 mm) and often occurred in large numbers under pats along the west coast, particularly during the winter. *Harpalomorphus capicola*, which was not as abundant, was collected only in the north-western parts. *Harpalodes xanthorhaphus*, common under kelp, and *Geobaenus lateralis* Dejean (Fig. 2C) are both widely distributed and occurred under dry pats in fair numbers in almost all the areas surveyed.

Some carabids are generally attracted to fresh dung, particularly *Amblystomus capensis* (Motschulsky) (Fig. 1A), but only very small numbers were observed. On the other hand the shiny, reddish-black *Tachys capicola* Péringuey (Fig. 2H), which is about the same size as *A. capensis*, is a common species in leaf litter in the Cape Peninsula and also occurs in soil rich in compost.

A small, oval, pale straw-coloured carabid, *Omophron capicola* Chaudoir (about 6.9 mm long), is often encountered in sandy areas along the western parts of the southern coastal region. It resembles the tenebrionid, *Pachyphaleria capensis* (Castelnau), but can easily be distinguished by the metallic green patches on the head, median area of the prothorax and elytra, and by the sickle-shaped mandibles, the large eyes and longer antennae. It was observed to stalk *Machilinus* sp. (Order Microcoryphia) common on the debris in these regions, and probably feeds on this machilid.

#### *Laemostenus complanatus* Dejean

##### DESCRIPTION

*Adult* (Fig. 3J).

Previously described by Péringuey (1896) and Hinton (1945). Black to dark brownish black in colour, head and thorax fairly shiny, elytra duller, with somewhat silky sheen. Antennae, palpi and tarsi reddish brown; first three antennal segments devoid of pubescence, segments 4–11 pubescent. Elytral striae fine but clearly indicated.

This is a cosmopolitan species and, according to Hinton (1945), apparently a native of Europe or north Africa. According to collection data found only around Cape Town, on the Cape Flats, Robben Island, and near Stellenbosch.

In Britain it appears in granaries and in glue and chemical works (Hinton 1945) and, according to Pescott & Miller (1937), the adults were observed to prey on the larvae of the codling-moth, *Cydia pomonella* (Linnaeus) in Australia. Around Cape Town it is commonly attracted to decaying carcasses and compost heaps.

*Larva* (Fig. 3A–B)

A general description of carabid larvae is given by Van Emden (1942). Elongate, subcylindrical and 16.6–17 mm long when full grown.

Body creamy white, with tergites and sternites pale piceous brown. Head directed slightly upwards. Pronotal tergite largest and also more strongly sclerotized, all tergites divided by a thin, pale, longitudinal median line. Mesothoracic spiracle largest and oval; abdominal spiracles (of which one on first segment is larger than rest) annular (Fig. 3P). Two lateral abdominal sclerites present, of which upper one bears five and lower one six setae, except in eighth segment where both have five setae in all specimens examined. Ninth segment with only one lateral sclerite bearing only two setae, and also with two long cerci, each with nine long setae. Tenth segment tubular and functioning as a proleg. Sternal region (Fig. 3L) of abdominal segments 1–7 each with single large anterior ventrite bearing eight to ten setae and four posterior postventrites, of which inner pair bears two and outer pair four setae. One pair of minute praeventrites also present. Sterna 8 and 9 with sclerites fused into a single plate, which is divided posteriorly on eighth segment. Sternal plate on eighth segment with thirteen to fourteen setae, that on ninth segment with ten to twelve. Each tergum with nineteen to twenty setae, except that of eighth segment, which has ten to twelve only, and ninth segment, which has four, one of which is situated on base of each cercus.

Legs (Fig. 3D) with some scattered setae on coxae, each trochanter with two posterior and about four anterior spine-like setae, as well as two long ventral setae. Femur with a double ventral row of four to five spine-like setae and single short seta dorsally near apex. Tibia with about six spine-like setae around apex. Tarsus slightly longer than tibia, bearing two spine-like apical setae dorsally and two simple, acute claws, which are only slightly shorter than tarsus. Compare with Staphylinidae where legs are four-segmented (Figs 9E, 10F, 11E, 13F, 14E).

Young larvae collected during September resemble mature specimens in form, shape, and number of setae present on head and thorax, but middle tooth-like process in mandibles is much more acute, and (in the few specimens examined) third seta on cercus is branched (Fig. 3O). Abdominal sterna are not fully differentiated into various sclerites present in later instars.

*Head capsule* (Fig. 3C, F–G)

Dark reddish brown, finely reticulate, somewhat shiny. Frontal and epicranial sutures distinct; neck absent. Cervical keels well indicated. Nasale



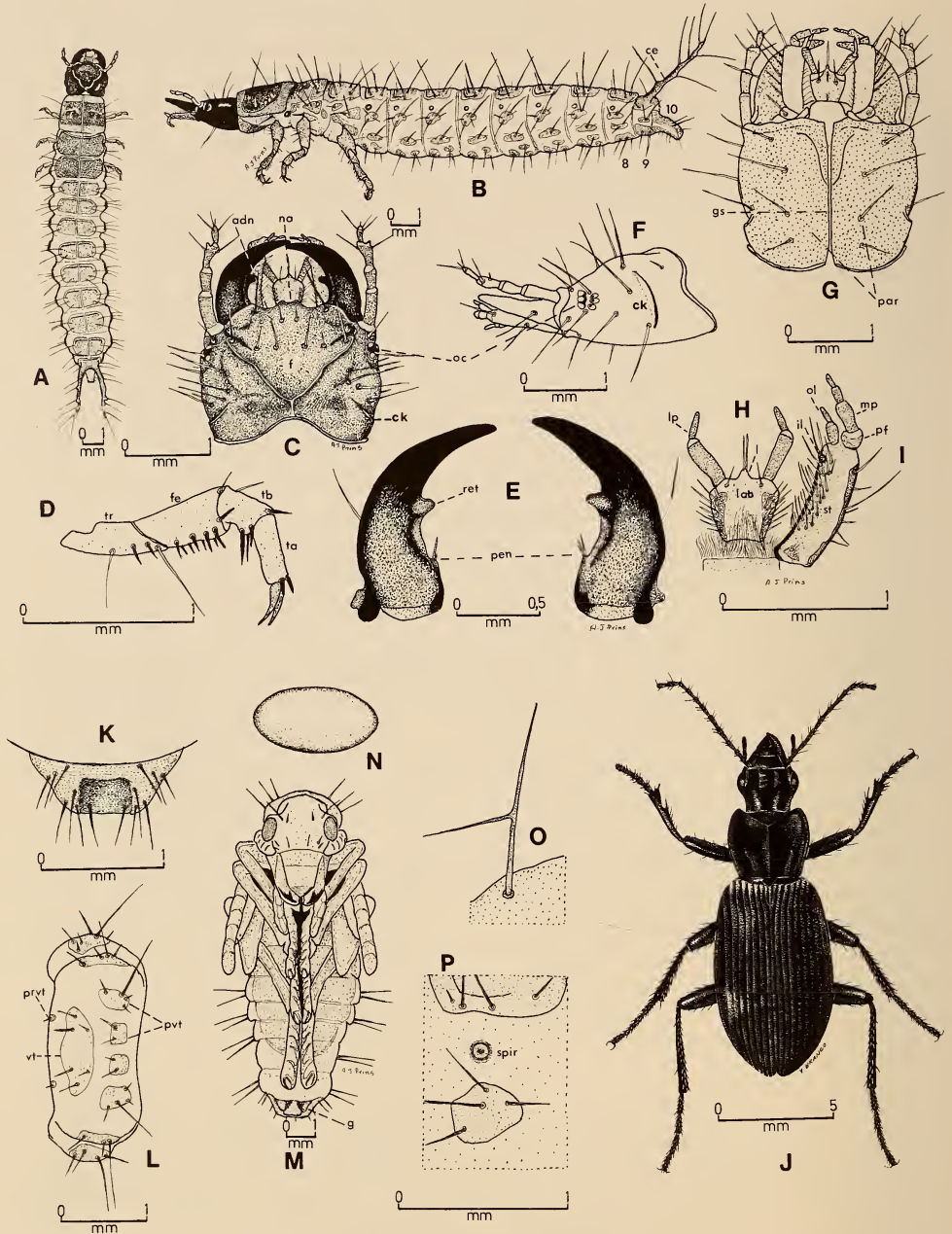


Fig. 3. Family Carabidae.

*Laemostenus complanatus*. A. Larva (dorsal view). B. Larva (left lateral view). C. Head (dorsal view). D. Right mesothoracic leg (posterior view). E. Mandibles (dorsal view). F. Head (left lateral view). G. Head (ventral view). H. Labium (dorsal view). I. Right maxilla (dorsal view). J. Adult. K. Last abdominal segment of pupa (dorsal view) to show depression. L. Second abdominal sternite. M. Pupa (ventral view) with beetle already fully developed. N. Egg. O. Third seta on cercus to show branch (highly magnified). P. First abdominal segment to show spiracle.



somewhat prolonged, shallowly emarginate in the middle and also very slightly so on each side; adnasalia slightly concave; two parietalia dorsally and laterally with about eight setae each. Chaetotaxy as illustrated. Six ocelli present on each side. Antennae four-segmented, fourth segment small, slightly shorter than third; latter with sensorial appendages on exterior side; penultimate segment with one short dorsal seta and two lateral ones; apical segment (fourth) also with one dorsal seta and two lateral ones, and also bearing short setae at extreme apex. Antennal base not very clearly demarcated and bearing single lateral seta. Hind margin of head deeply excavated medially on dorsal side, ventrally only slightly so. Gular suture distinct and with V-shaped notch nearly half-way between anterior and posterior margins.

*Mandibles* (Fig. 3E)

Falcate, length slightly more than twice the width at base. Apex fairly acute, colour dark reddish brown, almost black in old specimens. Retinaculum present; subbasal penicillus represented by one or few setae in most specimens examined. Exterior lateral side with depression, bearing single long seta.

*Maxillae* (Fig. 3I)

With large almost rectangular stipes. Ventrally smooth and with about six setae, of which one is very long, on external margin; dorsally beset with numerous setae on mesal side. Outer lobe of maxilla palpiform and two-segmented, with single ventral seta on first segment. Inner lobe present as small conical process, with single long style-like seta at apex. Cardo ventrally with a single seta. Maxillary palpus three-segmented, with apical segment small, about half the length of first. Palpifer segment-shaped and with single ventral seta. Palpi devoid of setae.

*Labium* (Fig. 3H)

Trapezoidal, with base narrower than apex. Ventrally divided by shallow longitudinal furrow into two lobes, each bearing single seta apically. Ligula prolonged in front and bisetose. Lateral margin of labium sclerotized and bearing numerous setae. Palpiger with single seta. Labium basally covered with long, fine hairs. Labial palp two-segmented, with apical segment small, about half the length of first.

*Pupa* (Fig. 3M)

Pupa about 16,6 mm long. Almost pure white soon after pupation, but mandibles gradually become red; 3–4 days before beetle emerges, black eyes begin to show through integument. Head and thorax with some scattered brown setae dorsally. Abdominal terga with about nine long brownish-black setae on each side; laterally also with two setae, except the last two or three terga, which bear only few setae. Developing genital capsule represented by two conical tubercles. Terminal abdominal tergum with almost square depression, the lateral sides of which bear four to six setae (Fig. 3K).

## BIOLOGY

Both adults and larvae are predacious and feed on various insects in the soil; those collected from the carcasses fed in the laboratory mainly on fly larvae and the grubs of skin-and-hide beetles. The maggots and pupae of the cheese skipper, *Piophilha megastigmata* McAlpine, also seemed to be a favoured source of nourishment, as well as the caterpillars of tineids.

Beetles with fully developed eggs were collected under carcasses during April and May. These eggs (Fig. 3N) measure 1,6 mm × 0,88 mm and are oval shaped, almost pure white, with the surface microscopically wrinkled or shagreened and somewhat dull. Some beetles were found hibernating under the bark of trees and under stones; those collected during September survived for at least 6 months and bred larvae during the early winter. Full-grown larvae appeared from September to October and pupae were found from October to November. There was only one generation a year during the survey period; however, overlapping occurs and young larvae measuring 4,5 mm were observed during spring. The fully mature larvae construct clay cells in which they remain dormant for a short period (3–20 days) after which they pupate. Pupal stages varied from 11 to 13 days in the laboratory during the late spring and early summer (21–23 °C).

Newly emerged beetles are pale whitish brown, but after about a day the head and thorax become blackish; some 3 days later they usually assume their normal black colour.

Family **Hydrophilidae**

Small to medium-sized oval beetles, the dorsum smooth and convex, and the head prominent. Maxillary palpi fairly long and antennae seven to ten-segmented. Tarsal formula 5–5–5 or 5–4–4. Wings well developed.

Some seventy species have been described from southern Africa, most of which are aquatic or at least semi-aquatic; those of the subfamily Sphaeridiinae are terrestrial, restricted to wet or damp places and breed in dung and other decaying matter; larval breathing in this case is pseudometapneustic. Very little is known about the habits of one genus, *Coelostoma*; according to Böving & Henriksen (1938) the presence of suckers on the underside of the abdomen of the larvae may indicate that they are adapted for moving over rough or hard surfaces such as rotten leaves, etc. Adults of *Coelostoma punctulatum* (Klug) were collected on the green algae growing in stagnant pools in the vicinity of Laingsburg.

At least six species of water scavenger-beetles belonging to the above-mentioned subfamily are common in fresh cow-pats in the areas surveyed. When the dung starts to dry out, however, some of these beetles, together with some of the histerids and staphylinids, which are attracted, generally leave the pats, except those that prefer the drier media. The mandibles of the adult beetles are much better sclerotized than in the coprophagous *Aphodius* species (Scarabaeidae) and they are thus adapted to feed on much drier and harder dung particles,

and predation may not be entirely excluded. Most of these beetles therefore remain in the dung much longer than the smaller scarabs and are often found in fairly dry pats.

*Cercyon maritimus* Knisch was the most common species found in dung. In Mamre (south-western Cape) quite a large number of the rather small Palaearctic and Nearctic hydrophilid *Cercyon pygmaeus* (Illiger) occurred in association with *C. maritimus* during the early spring, but its larvae could not be traced. It was fairly abundant along the south coast during the late summer and autumn in both semi-fresh and almost dry cow-dung.

*Sphaeridium caffrum* Laporte & Castelnau appeared in large numbers during the winter and spring in the western parts of the Cape and was very numerous during the late summer when larvae and pupae were present in fresh dung in almost all areas. The related *S. quinquemaculatum* Fabricius (length about 3 mm), which is similar to, but smaller than, *S. caffrum* occurred during the summer in Montagu. It is widespread, not only in the Cape Province but also in other parts of the world such as Sri Lanka, southern Asia, China, and Taiwan (Knisch 1924b). *Sphaeridium caffrum*, however, is known only from the Sub-saharan and Malagasy regions.

*Pachysternum capense* (Mulsant), on the other hand, which is also small (2.3–2.5 mm long), occurred in fair numbers together with *Sphaeridium quinquemaculatum* in Montagu and can be distinguished from the latter by having inconspicuous longitudinal striae on the elytra. It was common in the Karoo and along the west coast, often in association with *S. caffrum*. In the Sandveld an unidentified species (2.3–3.1 mm long), with blackish head and pronotum and pale straw-coloured elytra, appeared with *P. capense* in the same cow-pats.

*Cercyon maritimus* and *C. gigas* d'Orchymont usually also breed in decaying kelp and may even be found in the decaying carcasses of marine animals and birds. According to collection data, the latter species is endemic to the Cape Province, and is mainly dark brown with narrow, longitudinal blackish stripes over its elytra.

A third, peculiar, small hydrophilid *Spercheus cerisyi* Guerin-Méneville (about 4 mm long and pale brownish grey in colour) appeared to be common on kelp during the winter and spring in estuaries around the Cape Peninsula. It was very often associated with the chrysomelid *Monolepta bioculata* (Fabricius) (of about the same size), which has four large, oval white spots surrounded by black margins on the dorsum of its orange body. Both beetles were found to feed on the fluids oozing from the decaying kelp. This hydrophilid (subfamily Spercheinae) is apparently a water-living species.

#### *Cercyon maritimus* Knisch

##### DESCRIPTION

##### *Adult* (Fig. 4A)

Previously described by Knisch (1924a). Small, rather variable beetles, varying in colour from brown to almost pitch black; in some cases elytra brownish,

marked with black. Each elytron with about nine shallow punctured striae and densely pitted all over, the pits small and as wide apart as their diameter. Beetles vary from 3,7 to 4,6 mm in length.

Widely distributed along the Cape coasts.

#### *Larva* (Fig. 4B)

Resembles larva of histerids, but easily distinguished by the last abdominal segment or stigmatic atrium (Fig. 4M), which consists of the tergal plate of the eighth segment, the median and lateral lobes of the ninth segment (lateral lobes also known as acrocerci), the true cerci or mesocerci, each with a long filament at apex, and the pro-cerci, which are actually processes of the eighth pleurites. All spiracles including those of mesothorax of equal size and of biforous type; seven pairs laterally on abdomen, eighth pair opening in atrium. Pro-, meso- and metathoracic shields well developed, though small on last two thoracic segments. Full-grown larvae measuring 10–11 mm in length and dirty to creamy white in colour, except head, thoracic shields and eighth abdominal plates, which are reddish brown and somewhat shiny. Body integument leathery, tough and covered with microscopic spinules (Fig. 4N). Legs present, with femur and tibia distinguishable although minute (contradicts Richmond's (1920) statement that legs are entirely absent in *Cercyon*).

#### *Head capsule* (Fig. 4C–D)

Oval, somewhat upwardly directed in most specimens seen, with small ocellus on each side. Frontal sutures not visible. Antennae three-segmented, with first segment about twice as long as the second; latter with small, apparently two-segmented appendage; third segment smaller than the second and with some sensory pegs apically. Postgenae ventrally separated by gular suture, which is Y-shaped and delimits a pre-gular area anteriorly between its arms. Arrow-shaped tentorial pit posteriorly, almost in centre. Chaetotaxy as illustrated.

#### *Mandibles* (Fig. 4H, L)

About half as long as cranium and nearly one-third longer than wide. Broad basally, cutting edge of left mandible without teeth, that of right mandible with single short tooth ( $t_1$ ) about half-way between apex and molar area. Teeth very similar to those of *C. quisquilius* (Linnaeus) (Hafez 1939d). Molar area thin and almost trenchant in both mandibles, forming a ridge rather than teeth; that of left mandible somewhat broader than that on right. Penicilli not present in the specimens examined. Ventral side of left mandible with longitudinal, curved median groove visible through dorsal integument for reception of right mandible.

#### *Maxillae* (Fig. 4I–J)

With broad cardo and stipes, nearly twice longer than wide and with more or less shiny, oval area dorsolaterally furnished with fine setae; mesal margin bearing eight to nine short setae. Fairly long seta also present apically on lateral



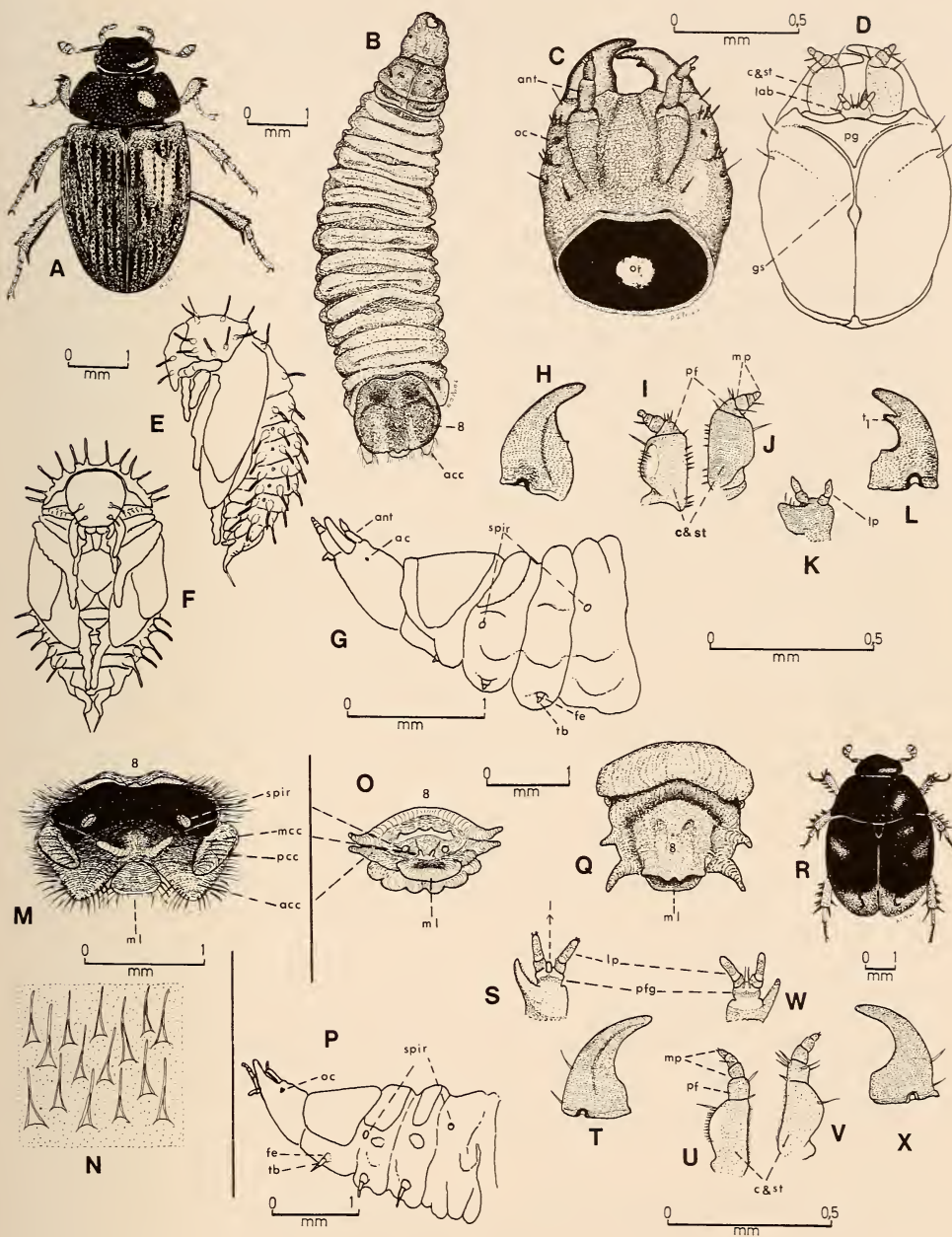


Fig. 4. Family Hydrophilidae.

A-N. *Cercyon maritimus*. A. Adult. B. Larva (dorsal view). C. Head (dorsal view). D. Head (ventral view). E. Pupa (left lateral view). F. Pupa (ventral view). G. First three segments of larva (left lateral view). H. Left mandible (dorsal view). I. Left maxilla (dorsal view). J. Left maxilla (ventral view). K. Labium (dorsal view). L. Right mandible (dorsal view). M. Atrium, straight from behind. N. Integument showing spinules (highly magnified). O-X. *Sphaeridium caffrum*. O. Atrium, straight from behind. P. First three segments of larva (left lateral view). Q. Atrium (dorsal view). R. Adult. S. Labium (dorsal view). T. Left mandible (dorsal view). U. Left maxilla (dorsal view). V. Left maxilla (ventral view). W. Labium (ventral view). X. Right mandible (dorsal view).

side. Ventrally without setae. Maxillary palp three-segmented, with segments tapering towards the apex and of about equal length, the second segment bearing long seta. Apical segment with sensory pegs at apex. Palpifer segment-like and bearing two long setae ventrally; also two to three shorter setae near apical border on mesal side, probably remnant of galea. Short spine-like seta also present basally on mesal margin.

*Labium* (Fig. 4K)

Small, represented by prementum and two-segmented palpi. Mentum dorsally asymmetrically developed in all specimens seen, forming long, almost triangular projection on left side, which bears some short setae on anterior part. When viewed from below a small part of this projection is visible on mesal side of left cardo-stipes.

*Pupa* (Fig. 4E-F)

Almost pure white after pupation, but soon changes to straw-yellow with blackish eyes. Head with four tubercles, each bearing long, thick seta or stylus; pronotum with about ten stylus-bearing tubercles on anterior and posterior margin as well as two near middle. Meso- and metathorax with stylus-bearing tubercle on each side of median line. Abdomen on each side with three rows of stylus-bearing tubercles, of which one row is situated laterally. Wings folded down over ventral side of body. Developing genital capsule present as two small, elongate cones situated close together. Fleshy cerci divergent in most specimens studied, each with long filament attached to larval skin. Five pairs of spiracles clearly visible, sixth pair small and inconspicuous. Body length of specimens examined 3,7-5,5 mm.

BIOLOGY

Adults and larvae were observed almost throughout the year, mostly in kelp, but sometimes also in fresh cow-dung. As already stated, the larvae are mainly predacious, but will feed on the colloids oozing from decaying kelp. Larvae collected in this medium along the west coast during spring had a life-span of at least 40 days before pupation occurred. Most pupae were found in the top few centimetres of soil in oval earthen cells constructed by the larvae. Pupal stages varied from 9 to 12 days during August and September, the newly emerged beetles being yellowish white with some orange coloration on pronotum. Those observed assumed their normal dark colour after a few days to about a week.

*Sphaeridium caffrum* Laporte & Castelnau

DESCRIPTION

*Adult* (Fig. 4R)

Length 4,3-5,5 mm. Oval, black, only slightly shiny, with fulvous or paler spot near base of each elytron as well as fulvous or paler area on apical third of

elytra. Latter without longitudinal striae but densely punctate, the punctures being small and shallow. External border of elytra also pale fulvous. Legs brownish, furnished with spines.

Widely distributed in South and east Africa and Madagascar (Knish 1924*b*). Specimens studied here were collected mostly in the western parts of the Cape Province.

#### *Larva*

Very similar to *Cercyon maritimus*, but easily distinguished by absence of extra tooth on right mandible and by stigmatic atrium, which bears two fleshy projections on each side (the procerci and acrocerci) (Fig. 4Q). Eighth pair of spiracles also opens into atrium. Mesocerci much shorter than in *C. maritimus* and also furnished apically with filament or seta; median lobe broader than in latter species (Fig. 4O), its hind margin almost quadridentate as in *Sphaeridium scarabaeoides* (Linnaeus) (Hafez 1939*b*). Seven pairs of biforous spiracles present laterally on abdomen. Legs much larger than in *C. maritimus* and, apart from femur and tibia (with circle of about nine short setae around apex), third or tarsal segment with one or two setae at tip also present (Fig. 4P). Integument leathery and covered with minute spinules similar to those of *C. maritimus*; also some short setae present. Full-grown larvae measure 8–9,5 mm and are of same colour as those of the latter species.

#### *Head capsule*

Very similar to that of *C. maritimus*, including structure of gular suture; also without frontal suture. With two to three ocelli on each side. Integument fairly shiny and brown and cranium wider behind than in front. The antennae three-segmented as in *C. maritimus*, but projection on second segment lacking; second segment also about half the length of first; third segment smallest and with short setae or sensory pegs at tip.

#### *Mandibles* (Fig. 4T, X)

Similar to those of *C. maritimus*, including the ventral groove on left mandible, but lacking tooth between apex and molar area on right mandible. Molar areas trenchant. Two small setae usually present on exterior sides, one situated near base.

#### *Maxillae* (Fig. 4U–V)

Very similar to those of *C. maritimus*, with cardo-stipes somewhat extended on exterior side and with long seta and also with about four shorter setae ventrally. Mesal margin with numerous very fine setae, otherwise exactly as in *C. maritimus*, including setae on palpifers. Second palpal segment with short seta on both mesal and lateral margin; apical segment with short spine-like seta near base on mesal side, and with sensory pegs at apex.



*Labium* (Fig. 4S, W)

Very similar to that of *C. maritimus*, but differs from it by longer labial palpi, longer and more pointed projection on left side, which is furnished with fine setae on anterior margin and by presence of a short ligula, which is about three-quarters the length of first segment of palpi. Palpiger about as long as first segment of palpus.

*Pupa*

Very similar to that of *C. maritimus*, including apical cerci and styli. Number of styli on body and particularly those on head and pronotum also similar to those of latter species, although much longer and thinner in all specimens examined. Cerci somewhat shorter than in *C. maritimus*. Most pupae about 5.4 mm long. Colour of pupae at first more or less creamy white, but eyes become brown after a few days. Whole pupa changes to darker colour just before beetle emerges.

## BIOLOGY

Large numbers of beetles were collected in fresh and semi-fresh cow-pats in the western parts of the Cape during the summer and autumn and larvae were observed during the early part of the summer, producing pupae during December and January. The larvae pupate in small cells constructed in the drier parts of the dung and, to judge from their intestinal contents, most of the larvae collected in the pats must have been feeding mostly on the decaying material, particularly the liquids oozing from the wet particles. When crowding occurs they become cannibalistic.

Family **Histeridae**

Very small to medium-sized, oval hard-bodied beetles, head deeply sunk into prothorax, short legs and eleven-segmented antennae capable of being retracted. Tarsal formula 5-5-5 or 5-5-4. Wings well developed; elytra usually not covering last two abdominal segments.

Some 150 species of histerids have already been described from southern Africa, most of which are predacious on coleopterous and dipterous larvae and other smaller arthropods. According to Nuorteva (1970), who experimented with histerids in Finland, there is a very high negative correlation between the occurrence of blow-flies and histerids in fish carcasses. Bornemissza (1968) reported up to 50 per cent kill of fly maggots in cow-pats by *Pachylister chinensis* (Quensel) in Fiji. Some species, however, live in the burrows of small mammals or in the nests of birds (Arnett 1963), particularly species of *Saprinus*, *Gnathoncus*, and *Hister*; others again have developed a myrmecophilous or termitophilous life, such as species of *Monoplius* as well as *Hister*. Species of *Teretrius*, which are cylindrical in form, live in the burrows of wood-boring beetles, whereas the flat species of the genera *Hololepta*, *Pachycraerus*, and *Paromalus* are



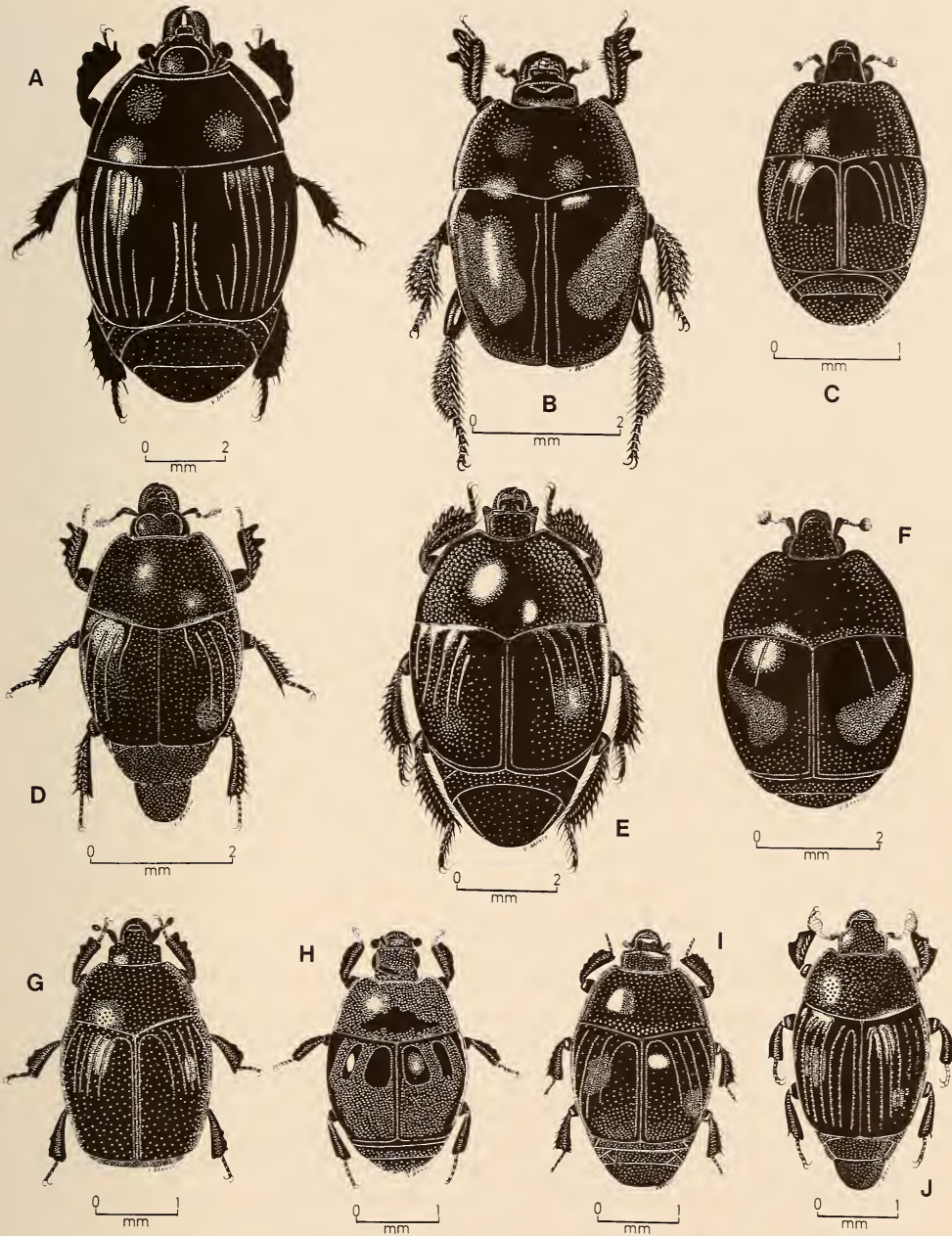


Fig. 5. Family Histeridae.

A. *Hister nomas*. B. *Pachylopus dispar*. C. *Saprinus cupreus*. D. *Rhylochares saprinoides*.  
 E. *Saprinus elegans*. F. *Saprinus nitidus*. G. *Gnathoncus rotundatus*. H. *Hypocaccus specillum*. I. *Hypocacculus harmonicus*. J. *Carcinops minuta*.

found under the bark of plants. At least four species of *Pachycraerus* have been collected in Natal under the bark of *Euphorbia* species.

One of the largest histerids found in South Africa is the black, almost smooth *Macrolister maximus* (Olivier) about 25 mm long, widely distributed in the Republic of South Africa, Botswana, Zimbabwe, and west Africa but it is not common. During the recent surveys at least fifteen species have been found in decaying matter, of which *Saprinus bicolor* (Fabricius), *S. cupreus* Erichson, and *S. nitidus* (Wiedemann) were the most abundant. *Saprinus bicolor* occurred mostly in carcasses, both on the beach and inland, whereas *S. cupreus* visited both carcasses and cow-dung. *Saprinus nitidus* was the most common species in fresh dung and was followed by *Hister nomas* Erichson, *H. contemptus* Marseul, *Atholus conformis* (Erichson), the small *Hypocacculus harmonicus* (Marseul), and *Abraeus setulosus* Fahraeus.

*Saprinus nitidus* (Fig. 5F) is a rather small beetle (2,8–4,2 mm long), shiny black with a fairly large, somewhat diffuse reddish spot as well as two short oblique striae on each elytron. *Saprinus cupreus* (about 3,3 mm long) (Fig. 5C), is a shiny black beetle about the same size as *S. nitidus* (Fig. 5F), but lacks the reddish spots on the elytra. *Hypocacculus harmonicus* (Fig. 5I) is also shiny black but smaller than *Saprinus nitidus* and is only 1,2–1,4 mm long. *Abraeus setulosus* (1,2–1,8 mm long) is almost dull, densely punctate, and characterized by the presence of short club-shaped hairs. These beetles are widely distributed in South Africa and even occur in semi-fresh and almost dry dung.

The shiny black *Hister nomas* (about 8 mm long) (Fig. 5A), with about seven striae on each elytron, was collected mostly in fresh dung in Heidelberg, Cape Province, particularly during the spring; it was accompanied by the smaller and similar *Atholus conformis*. *Hister contemptus* is about the same size as *H. nomas* but has only about five striae on each elytron. None of these beetles seemed to breed in the dung. Species belonging to the genera *Hister* and *Atholus* mentioned here are easily recognized by the stria that runs parallel to the lateral and anterior margins of the pronotum (Fig. 5A).

Three other species, *Rhyphochares saprinoides* (Erichson) (Fig. 5D), *Hypocacculus specillum* (Marseul) (Fig. 5H), and *Tribalus capensis* (Paykull) were found to be prevalent in semi-dry and dry cow-pats and were never collected in fresh dung. All these species are black. *Rhyphochares saprinoides* (about 4,5 mm long), with indistinct striae on the elytra, and *H. specillum* (2,3 mm long), dull black with five shiny patches on its body, are endemic to the Cape Province according to collection data, and are common, but not numerous, in the western parts that were surveyed. The widespread *Tribalus capensis* (about 2,9 mm long) is slightly shiny and oval, the striae on the elytra being almost obsolete. Most of these beetles were observed to feed on the small scarab larvae and on the larvae of any smaller flies that happened to be present.

Soils rich in decaying organic matter, such as compost and fish-meal, attracted the shiny greenish-black *Saprinus elegans* (Paykull) (Fig. 5E), whereas fowl manure, particularly in fowl-pens of the closed type in which the larvae of

the lesser meal-worm, *Alphitobius diaperinus* (Panzer), and those of the skin-and-hide beetle, *Dermestes maculatus* de Geer, were present, produced large numbers of *Carcinops minuta* (Fahraeus) (Fig. 5J) and *Gnathoncus rotundatus* (Kugelann) (Fig. 5G). These two species are common in the Cape Peninsula in decaying carcasses when fly larvae develop, together with the previously mentioned *Saprinus bicolor* and *S. cupreus*. Both *Carcinops minuta* and *Gnathoncus rotundatus* are rather small beetles, the latter more quadrate, with coarser puncturation than the first, the striae covering only a portion of the elytral surface.

In decaying kelp usually two species only of Histeridae were observed, and these fed mainly on the immature stages of the flies that were present. *Pachylopus dispar* Erichson (Fig. 5B), the larger of the two species (3.1–3.5 mm), is dull black in colour without any sculpture on its body and was often found feeding on small maggots in decaying red bait (*Pyura stolonifera* (Heller)). The other species, *Acritus lightfooti* Lewis, is very small (1.4 mm), red-brown in colour and its body is finely rugosopunctate. There is evidence, however, that this species may also feed on Collembola, particularly the purplish *Anurida maritima* (Guerin).

#### *Saprinus bicolor* (Fabricius)

##### DESCRIPTION

##### *Adult* (Fig. 6L)

Oval, shiny, 4–6 mm long. Pronotum coppery black. Elytra blackish green to reddish black and finely rugosopunctate, with about five striae on each side near base; central disc of elytra smooth and only shallowly punctate. Pronotum punctate, with punctures larger on sides. Exposed tergites shiny and densely punctate. Legs shiny, brownish black, with all leg segments flattened and tibiae spined on dorsal side. All femora with grooves for receiving tibiae; grooves on front femora situated on anterior side, those on other legs on posterior side.

Widespread in South Africa and Zimbabwe (Thérond 1956).

##### *Larva* (Fig. 6B)

Full-grown larva 12–12.5 mm long and dirty creamy white, with head and pronotal shield yellowish brown; subcylindrical. First eight abdominal segments each with four annulets dorsally and lateroventrally with fleshy swellings which, in conjunction with small tenth segment, function as pseudopods. Cerci small, bisegmented, each bearing two terminal setae. Body sparsely covered with golden hairs; integument covered with conical spines (Fig. 6C) visible only under high magnification. All spiracles almost of same size, oval and of biforous type; twin opening clearly visible on ventral side. Mesothoracic spiracle situated ventrally above leg and tilted lengthways, so that long axis is in longitudinal position, with opening pointing forward. Legs (Fig. 6D) small but well developed, tarsungulus long, slightly shorter than tibia, which is nearly twice as long as femur. Both trochanter and femur with ventral seta and tarsungulus with small seta ventrally near base.



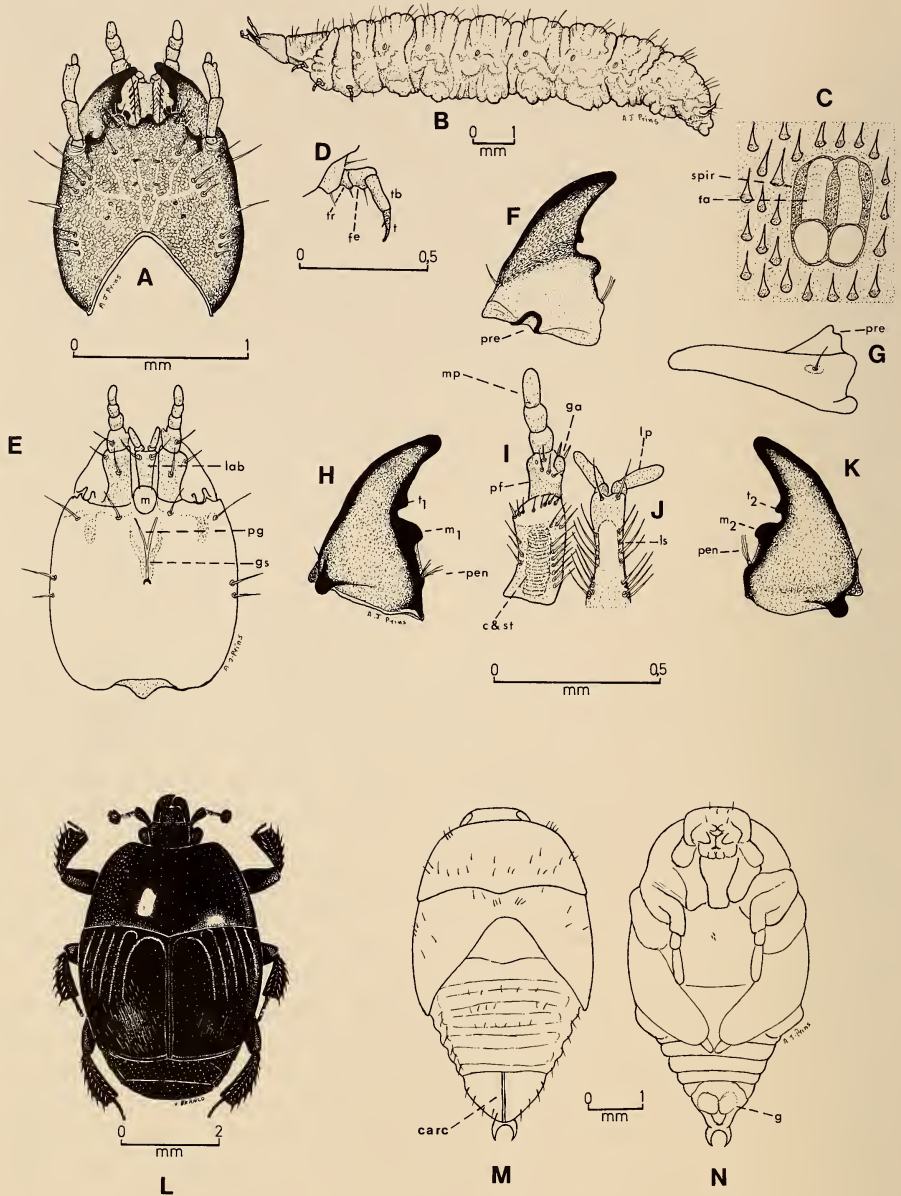


Fig. 6. Family Histeridae.

*Saprinus bicolor*. A. Head (dorsal view). B. Larva (left lateral view). C. Part of integument highly magnified to show spiracle and spines. D. Right leg (posterior view). E. Head (ventral view). F. Left mandible (dorsal view). G. Left mandible (exterior lateral side). H. Right mandible (ventral view). I. Left maxilla (dorsal view). J. Labium (dorsal view). K. Left mandible (ventral view). L. Adult. M. Pupa (dorsal view). N. Pupa (ventral view).



*Head capsule* (Fig. 6A, E)

Slightly upwardly inclined, about as long as wide and about as wide behind as in front; posterior margin deeply and angularly emarginate on dorsal side, ventrally only slightly so; dorsally somewhat shiny, microscopically reticulate and light reddish brown. No ocelli visible. Chaetotaxy as illustrated. Nasale extended and emarginate in middle, the two small teeth thus formed asymmetrical in specimens seen; right tooth larger than the left one; sinuate on each side of median extension and forming broad, rounded tooth on each lateral angle, cephalad of the antennae. Frontal and coronal sutures obsolete, but represented by some pale lines as shown in Figure 6A. Small pregula present ventrally between arms of Y-shaped gular suture, of which short stem ends in small posterior tentorial pit at centre of head; postgenae fused posteriorly and gular suture visible only as very shallow longitudinal impression. Antennae about as long as the mandibles; three-segmented, with third segment small, and penultimate one bearing sensory cone; all segments devoid of setae.

*Mandibles* (Fig. 6F-H, K)

Almost triangular, about half the length of cranium and about a third longer than wide at base. Cutting edge of both mandibles entire, apex rounded and with a small tooth ( $t_1$  and  $t_2$ ) near molar area, which distally bears a single rounded tooth ( $m_1$  and  $m_2$ ); proximally with a penicillus. Lateral margin rounded dorsoventrally, without dorsal carina and with small seta near base. Basal portion of mandible raised above the dorsal surface (Fig. 6G) for preartis to join condyle.

*Maxillae* (Fig. 6I)

Cardo and stipes united; latter dorsally with longitudinal excavation and with three setae on exterior margin and eight to ten setae on mesal; ventrally with only one seta. Apical border with six to eight dorsal setae. Palpifer segment-like, bearing one lateroventral and about four dorsal setae as well as small conical galea on mesal side. Palpus three-segmented, about as long as cardo and stipes and without setae. Galea with two small, palus-like setae.

*Labium* (Fig. 6J)

Labial stipes (prementum) long, with sides almost parallel and only two ventral setae near apex. Dorsally with row of about ten fairly long setae on each side of basal half and with two setae near apex. Labial palpi two-segmented, with apical segment about twice as long as basal one; both without setae.

*Pupa* (Fig. 6M-N)

Robust, measuring nearly 6 mm; white in colour with reddish head and mandibles. Body dorsally sparsely covered with short setae. Terminal abdominal segment with a crescent-shaped appendage at apex; dorsum of this segment almost triangular and with longitudinal carina; developing genitalia visible as two swellings on ventral side.

## BIOLOGY

Eggs of this species were found in the soil near decaying organic material containing developing fly maggots. The larvae feed mainly on small insects and when mature, construct a soft, silk-lined earthen cell in the soil in which they pupate. Diameter of most of the cells examined was 9,8 mm. The pupal stage lasted for about 13 days during April. The newly emerged beetle is dark brown on the head, with brownish-yellow pronotum. About two-thirds of the pronotal disc in most specimens examined is of a dark brown, the elytra and abdomen pale yellow, with brownish-yellow legs. After a day or two they assume their normal coloration.

*Carcinops minuta* (Fahraeus)

## DESCRIPTION

*Adult* (Fig. 5J)

Rather small, oval beetle, about 2,5 mm long, reddish black in colour, head black. Fairly shiny all over. Head and pronotum densely and minutely punctured; elytra with seven striae each, striae almost reaching hind margin; spaces between striae also have some fine punctures.

Collection records come from Cape Town and surrounding suburbs, and from Paarl. Also present in Natal, east Africa and Zaïre (Thérond 1956).

*Larva*

Similar to that of *Saprinus bicolor* but smaller, about 6,3 mm long when full grown, and more elongate. Cerci bisegmented and much longer than in latter species, apical segment with two long terminal setae (Fig. 7B). Legs much longer in relation to body than in *S. bicolor* (Fig. 7A). Integument of specimens examined without conical spines, but with rounded tubercles in pseudopodal areas (Fig. 7I).

*Head capsule* (Fig. 7C–D)

Slightly longer than wide, measuring 0,44 mm wide and 0,50 mm long in most specimens seen, about as wide behind as in front, the sides almost parallel, only slightly convex and somewhat sinuate behind antennae. Almost smooth and shiny, reddish brown to dark brown depending on degree of sclerotization; dorsally with some indistinct sulci as in drawing. Posterior margin dorsally deeply and angularly emarginate, ventrally widely and shallowly so. No ocelli observed. Chaetotaxy as in Figure 7C–D. Pregula very narrow. Nasale (Fig. 7E) in all specimens seen with two asymmetrical lobes in middle, that on left bidentate, right one stronger developed and tridentate. Characteristic of this species is the oblique carina dorsally on posterior one-third of cranium, which is absent in *S. bicolor*. Antennae slightly longer than mandibles, three-segmented; apical segment short, slightly more than half as long as the second, with terminal sensory pegs. First segment longest, about one-quarter longer than penultimate

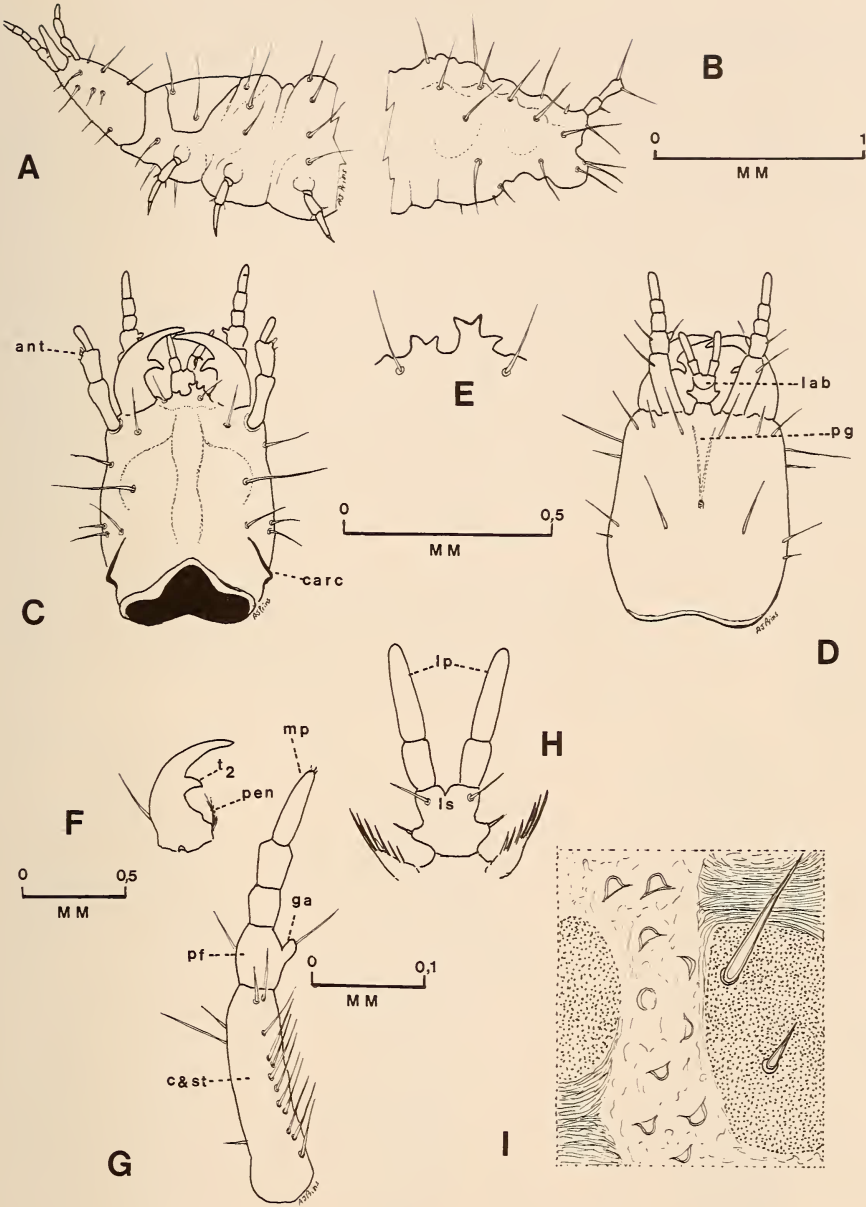


Fig. 7. Family Histeridae.

*Carcinops minuta*. A. Head and thoracic segments (left lateral view). B. Last two or three abdominal segments (left lateral view). C. Head (dorsal view). D. Head (ventral view). E. Nasale (highly magnified). F. Left mandible (dorsal view). G. Left maxilla (dorsal view). H. Labium (dorsal view) showing lobe-like structures with brush of hairs. I. Part of integument highly magnified to show tubercles.



one, which bears sensory cone and sensory pegs. All segments devoid of setae in the few specimens examined.

*Mandibles* (Fig. 7F)

Similar to those of *S. bicolor*, but more sickle-shaped, molar area much smaller, tooth  $t_2$  (also  $t_1$ —Fig. 6H) large and acute and situated in about the middle. Mandibles less than half the length of cranium, penicillus fairly long.

*Maxillae* (Fig. 7G)

Similar to those of *S. bicolor*, but united cardo and stipes much longer, dorsally with single row of about twelve long, fine hairs as well as two setae near apex, inner one the longest. Ventrally with a long seta; also two short setae on external side. Palpifer as in *S. bicolor*, with a ventral seta and conical galea, which is much more developed in this species and bears a long terminal seta. Maxillary palpi three-segmented, apical segment about as long as first and second taken together.

*Labium* (Fig. 7H)

Labial stipes very short, with two ventral and two dorsal setae, mentum produced on each side in form of a blunt tooth with a terminal spine-like seta. In this species there is dorsally a small lobe-like structure on each side of mentum, bearing a brush of thick hairs. Labial palpi two-segmented, with apical segment nearly twice as long as basal one, both without setae.

### Family Staphylinidae

A very large family of elongate, sombre-coloured rove-beetles, with short elytra exposing nearly always about half of the abdomen. They vary from very small to fairly large (about 30 mm or more); antennae usually eleven-segmented (sometimes nine- to ten-segmented), ocelli present in certain forms; hind wings usually well-developed. Tarsal formula 4-5-5, 4-4-4 or even 3-3-3 or 2-2-2.

The beetles abound wherever decaying organic matter accumulates, both along the shore and inland. Many species (subfamily Aleocharinae) live as termitophiles and myrmecophiles, while some species of the genus *Aleochara* are ectoparasitic on fly puparia, such as *A. salsipotens* Bernhauer (Fig. 8A), which were observed to destroy the pupae of the kelp-flies *Fucellia capensis* (Schiner) and *Coelopa africana* Malloch; however, this predation accounts for the destruction of only a very small percentage of the kelp-fly populations.

Some species, particularly those belonging to the subfamily Paederinae, when crushed against the skin, produce a blistering fluid that may cause severe irritation.

The larvae of staphylinids are campodeiform, active, predacious and usually somewhat flattened or depressed. Legs fairly long, four-segmented with a tarsungulus. Ocelli present or absent. Abdomen with ten segments.

Various rove-beetles have been observed in decaying kelp on the beaches, particularly *Cafius xantholoma* (Gravenhorst), which is widespread in Europe (Bernhauer & Schubert 1914) and regarded by Backlund (1945) as eucoenic. Morley (1907) suggests that it may even be omnivorous and will feed on mammal carcasses if necessary. During the present study it was found on carcasses of marine mammals on a few occasions, but appeared to feed on dipterous maggots under these circumstances.

Species of *Aleochara*, including the previously mentioned *A. salsipotens* (Fig. 8A), are some of the most numerous of all the Staphylinidae associated with kelp, together with species of *Omalium*, *Xantholinus* and *Bledius*, particularly *B. alutellus* Bernhauer. Most of them were found all along the coast as well as further inland in the survey area. A tiny, brown, *Omalium*-like *Phyllodrepa hessei* Bernhauer, (about 1.9 mm long) occurred only along the western part of the Cape Peninsula in kelp where the larger species were absent. The large black *Staphylinus hottentotus* Nordman (Fig. 8C), which is distributed throughout South Africa (Scheerpeltz 1973), was as numerous in kelp banks and flakes as in semi-fresh cow-dung and other decaying organic matter such as carcasses of marine and land animals.

The immature stages of *Aleochara* spp., *Bledius* spp., and *Staphylinus hottentotus* were never found in kelp during the surveys and their breeding habits are therefore unknown. However, the larvae and pupae of an unidentified *Aleo-*

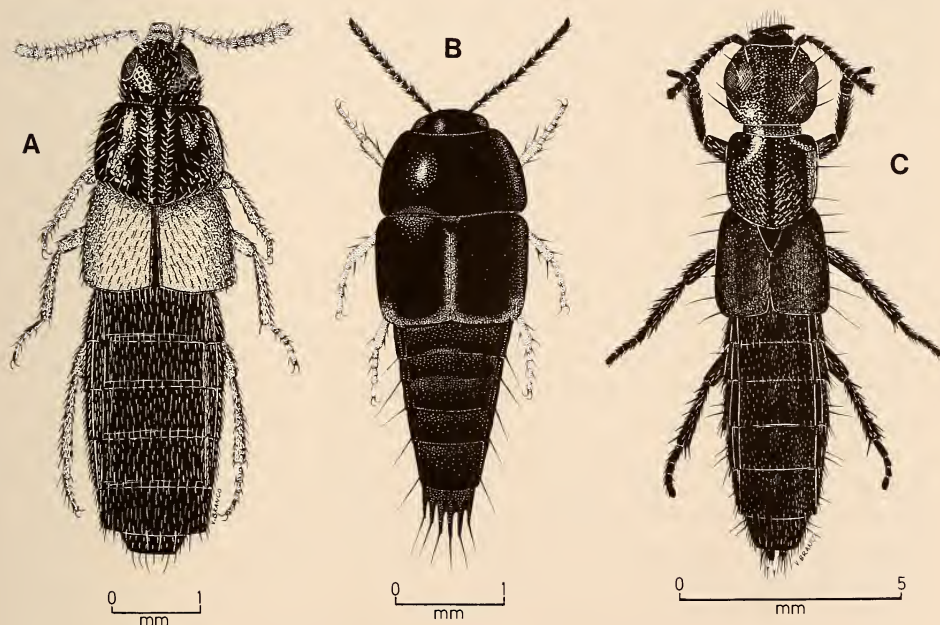


Fig. 8. Family Staphylinidae.

A. *Aleochara salsipotens*. B. *Leucoparyphus variipes*. C. *Staphylinus hottentotus*.

*chara* sp. (Fig. 9) were observed in semi-fresh cow-dung near Elands Bay during the winter, and those of *Omalium arenarium* (Bernhauer) (Fig. 10) in wrack near Kommetjie.

Fresh cow-dung on the beach and in the interior attracted mainly rove-beetles of the genera *Aleochara*, *Philonthus*, *Xantholinus*, and *Leptacinus*, all of them generally feeding on the flies and their larvae present in the dung, particularly the young larvae of the green dung-fly, *Orthellia peronii* (Robineau-Desvoidy), and those of the scarabs. *Oxytelus caffer* (Erichson) (Fig. 1C) and an unidentified species of both *Aleochara* and *Philonthus* (Fig. 1B), were the most numerous. All are black, except the one *Philonthus* sp., which has brownish elytra, and normally they all breed in the dung.

The *Philonthus* sp. (7,5–9 mm long) is fairly shiny, the *Aleochara* sp. (only 4,5–5 mm), on the other hand, is duller due to the presence of body hairs. All the species occurred almost throughout the year and are widely distributed throughout the whole area that was surveyed.

*Aleochara bipustulata* (Linnaeus) (3,2–3,7 mm long), another widespread species in the Cape Province as well as in the Palaearctic and Nearctic regions, occurred in cow-pats together with various other *Aleochara* and *Leptacinus* spp. and seems to have the same parasitic habits as *A. salsipotens*.

An unidentified *Philonthus* sp., very similar to the black species previously mentioned but more polished, particularly on the elytra, was found mainly in decaying birds in the vicinity of Cape Town. Occasionally the medium-sized, shiny, black *Philonthus natalensis* Boheman (Fig. 11J), occurred in fresh cow-pats near Heidelberg. Its large, oval, white eggs together with immature and mature larvae, which are characterized by the very long urogomphi, were collected occasionally during the late spring.

A black *Xantholinus* sp., (6,6–7,9 mm long), was fairly common in fresh dung throughout the region surveyed and also appeared in decaying kelp along the west coast. It is probably the same species that was found to visit decaying carcasses.

The peculiar *Leucoparyphus variipes* Fauvel (Fig. 8B), a small, shiny, black staphylinid (about 3,7 mm long), is common all along the south coast and was mostly attracted to cow-pats in which large numbers of the smaller flies belonging to the families Mycetophilidae, Sciaridae, and Sepsidae were breeding. It is very agile and distinctly resembles members of the order Thysanura.

When cow-pats have dried out to a certain extent, some of the species disappear to be replaced by others such as *Aleochara maura* Sachse, *Staphylinus hottentotus*, *Philonthus caffer* Boheman, and an elongate, yellowish-brown *Astenus* sp. *Oxytelus caffer*, *Aleochara bipustulata*, and some of the *Xantholinus* spp. were also observed to remain in fairly dry dung for long periods and were even found to continue to breed in pats as long as there was some moisture available.

A fairly large, agile and aggressive, unidentified *Staphylinus* sp. (Fig. 13M), chequered with golden yellow and brown, was found to breed in fairly dry to semi-fresh pats, both along the south and west coasts. When a cow-pat is picked



up, the large brownish larvae of this species are often found with open jaws and trying to escape into the soil. In the laboratory these larvae fed on various insects, but did not accept isopods.

The staphylinids that visited carcasses during the surveys included *Aleochara salsipotens* (mostly on the beach), *A. lateripennis* Bernhauer, *Oxytelus caffer*, *O. grandis* (Eppelsheim), *Staphylinus hottentotus* and at least one undetermined species each of *Aleochara*, *Oxytelus*, *Philonthus*, and *Xantholinus* (Fig. 14A). *Oxytelus grandis* is a shiny brown species that is widely distributed, occurring in Natal, Zimbabwe as well as in west Africa; all the other rove-beetles are black, except *Aleochara lateripennis* and the *Xantholinus* sp., which have light-reddish and brownish elytra respectively.

According to Kaufmann (1937) *Oxytelus* spp. and genera of the tribe Omaiini are absent during the warm weather and prefer the cold. However, in this study *Oxytelus caffer* was found throughout the year in fairly large numbers, both in cow-dung and carrion, and immature stages of this species and those of *O. grandis* were collected in bird carcasses along the west coast throughout the summer and autumn.

#### *Aleochara* sp.

##### DESCRIPTION

##### *Adult* (Fig. 9A)

Black and shiny, abundantly covered with medium-long, brownish, adpressed setae, particularly on head and thorax; abdomen more sparsely covered and therefore more shiny. Hairs grow from small pits, which are oval and larger on abdomen. Legs and antennae dark brownish. First three and apical antennal segments longer than wide, others as wide as or wider than long. Length 4,8–5 mm.

Widely distributed, collected in cow-dung almost throughout the areas surveyed.

##### *Larva* (Fig. 9B)

More robust than in *Philonthus* and *Staphylinus* spp., and more depressed dorsoventrally. Colour bright yellow to cadmium yellow, with oval brownish patch on each side of all body segments except pronotum. Mature specimens 4,6–5 mm long; sparsely covered with medium-long setae, of which four characteristically arranged medially near posterior border of the pro-, meso- and metanotum. Urogomphi (Fig. 9C) very small, apparently one-segmented, each with one long apical seta and one or two preapical setae. Spiracles circular and those on abdomen of same size and situated laterally; mesothoracic spiracles (Fig. 9K) ventral in position, somewhat larger and without setae (there is, however, a seta anterior to it). Legs (Fig. 9E) similar to those of other species, but with reduced number of setae, lacking especially rows of spines on femur; tarsungulus with one ventral and one dorsal spine. Integument dorsally covered with very fine, almost ultramicroscopic spicules; very few triangular denticles present and body hairs mostly simple.

*Head capsule* (Fig. 9D, F–G)

Smooth and shiny, pale golden yellow in colour; slightly wider behind than in front. Posterior margin slightly or widely emarginate, anterior margin straight and without teeth. Frontal sutures very indistinct and in some specimens indicated only by Y-shaped depression, but epicranial stem usually clearly demarcated. Setal pattern as illustrated. Neck absent. One ocellus present on each side, in some specimens not pigmented and may easily be overlooked. Hind margin deeply emarginate ventrally. Gula small, but clearly visible. Antennae three-segmented; apical segment small with three long subapical setae of which one is ventral in position, and with about four sensory pegs at apex; first and second segments of about equal length, second segment with two small ventral spines near apex and with sensory cone surrounded by about three long setae. Labrum free, trapezoidal, anterior margin slightly emarginate and bearing four long and two short setae; also transverse row of six setae medially, two of which are situated on oblique lateral face.

*Mandibles* (Fig. 9L, N)

Broad at base and tapering towards apex, thus appearing falcate; about half the length of cranium. Cutting edge of both mandibles bidentate, subapical tooth smaller than other. Molar area absent. Lateral margin fairly rounded dorsoventrally and with two setae placed far ventrally in specimens examined.

*Maxillae* (Fig. 9H, J)

Definite division between galea and lacinia (visible only on ventral side) and long seta on lateral margin. Lacinia with five spines and long seta on mesal margin; maxilla dorsally without setae but ventrally with three long setae on stipes and single long seta on cardo. Latter with Y-shaped suture. Maxillary palpi appear four-segmented in specimens examined, first segment short and bearing single seta on ventral side; second and apical segments of about equal length; penultimate segment slightly longer and bearing a single lateral and ventral seta.

*Labium* (Fig. 9I, M)

Labial stipes (prementum) apically with two-segmented labial palpi; short, broad, almost conical ligula present and two long subapical setae on ventral side. Mentum fairly large and almost conical and bearing four setae on ventral side. Boundary between mentum and prementum more strongly sclerotized and ventrally bearing short seta on each side. Submentum as broad as mentum and also bearing four setae ventrolaterally.

*Pupa* (Fig. 9O–P)

Pale lemon to cadmium yellow in colour, very pale soon after pupation; length 3.9–4 mm. Head with about eighteen short, brownish setae; pronotum with some short setae on front and hind margins and a parabolic transverse row

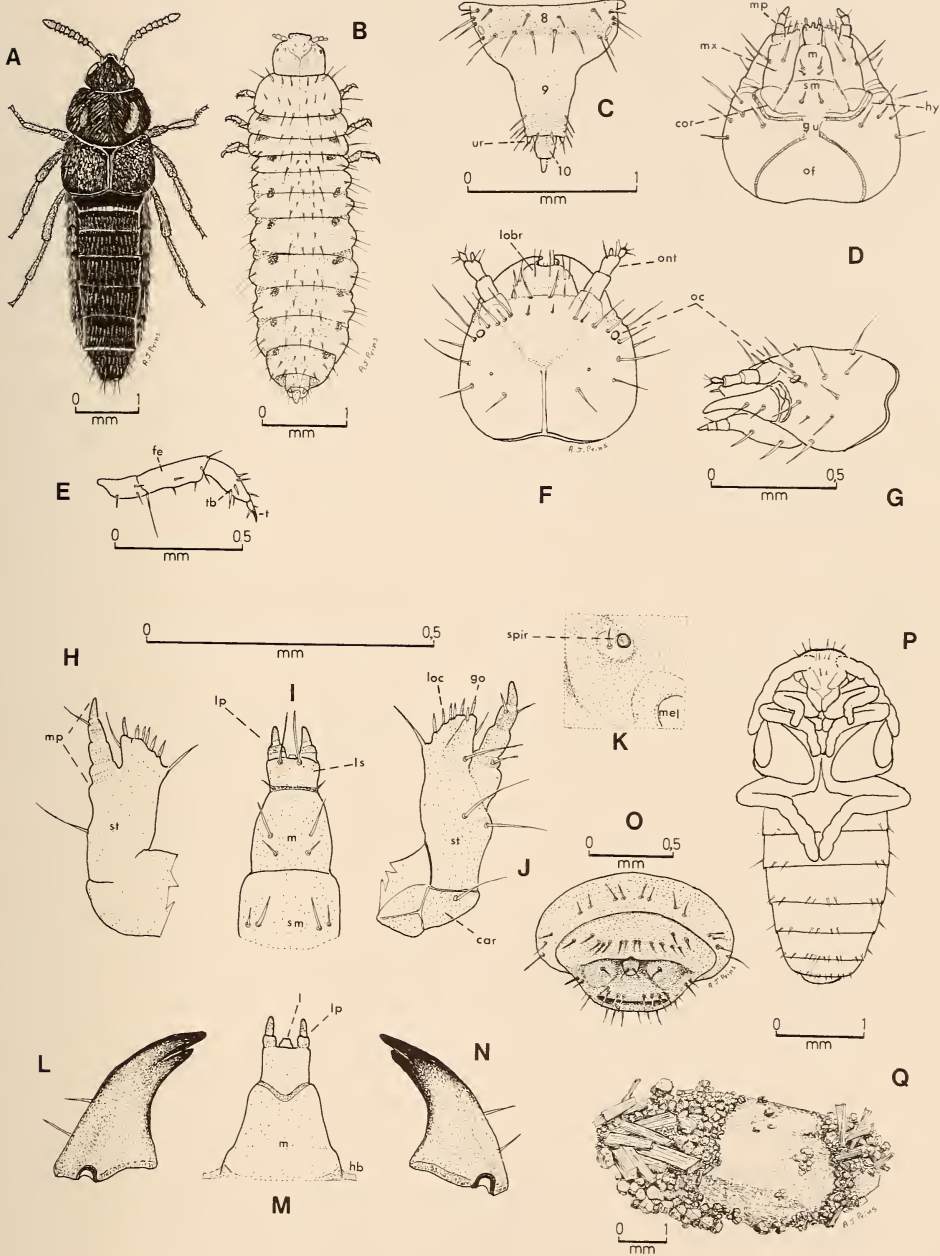


Fig. 9. Family Staphylinidae.

*Aleochara* sp. A. Adult. B. Larva (dorsal view). C. Abdominal segments 8-10 of mature larva (dorsal view). D. Head (ventral view). E. Right mesothoracic leg. F. Head (dorsal view). G. Head (left lateral view). H. Left maxilla (dorsal view). I. Labium (ventral view). J. Left maxilla (ventral view). K. Left mesothoracic spiracle. L. Left mandible (dorsal view). M. Labium (dorsal view). N. Right mandible (dorsal view). O. Abdominal apex of pupa (ventral view). P. Pupa (ventral view). Q. Pupal cocoon.



of about eight over its middle. Each abdominal tergum with transverse row of about nine short setae near posterior margin. Meso- and metanotum also with few short setae. Abdomen with few short setae ventrally as illustrated; first two sternites medially almost devoid of any setae. Developing genitalia (Fig. 9O) visible as small cone-like structure with two setae flanked on each side by somewhat raised area with centrally placed seta.

#### BIOLOGY

Larvae of this species were found in association with larvae of *Oxytelus caffer* in the western parts of the Cape during June; they were in semi-fresh cowpats, which also contained larvae of the scarab, *Aphodius laetus* Wiedemann. Mature larvae construct pale-brownish oval cocoons in the dung (Fig. 9Q), using their saliva and mixing it with dung particles. Pupation occurred after a short prepupal stage; the pupae observed appeared in July and the beetles emerged in August. Although the beetles were attracted to carcasses around Cape Town they did not reproduce under these circumstances.

#### *Omalium arenarium* (Bernhauer)

##### DESCRIPTION

##### *Adult* (Fig. 10O)

Light brownish in colour; abdomen somewhat darker, in some specimens piceous; head and scutellum black. Sparsely punctate; elytra also rugulose, shiny. Length 3,3–4,8 mm.

According to collection data it is endemic to the Cape, and during the surveys it was found along the west coast from Paternoster to Kommetjie.

##### *Larva* (Fig. 10P)

About 3,8 mm long when full grown and in dorsal view very similar to that of *Oxytelus caffer*, but cerci somewhat longer and, although also dark, they are not piceous; tenth segment also tubular and longer in relation to body. Sparsely covered with setae most of which are of 'frayed' type (Fig. 11L), particularly those forming transverse row in middle of each abdominal tergite (except last two tergites), which are stronger developed than others. As in *O. caffer* a thin, longitudinal, median line traverses thoracic segments and joins epicranial suture. Abdominal shields entire. Legs also similar to those of *O. caffer* and sparsely covered with spines; the tarsungulus long, acute and simple and with short posterodorsal and longer ventral spine some distance from base. Spiracles similar to those of *O. caffer* and similarly situated. Cerci (Fig. 10U) undivided and bearing two 'frayed' type setae on basal half, one on external margin and one dorsal, as well as two long ventrally situated setae, of which one is situated near apex; also two small spine-like setae, one just below exterior 'frayed' seta and one on internal margin, between the two long setae. Apex of cercus conical with single short

seta at base of cone. Integument of dorsal shields lacking triangular denticles found in *O. caffer*.

*Head capsule* (Fig. 10Q, T, V)

Sides slightly convex and frontal and epicranial sutures fairly distinct; neck absent. Five ocelli present on each side as illustrated. Hind margin almost straight or slightly emarginate with clypeofrontal suture obsolete in specimens examined. Labrum free, its anterior margin widely convex and devoid of any setae dorsally in most specimens seen, except two short submedian setae near anterior border. Extreme apical portion somewhat raised and with two longer setae and some spicules ventrally. Chaetotaxy as illustrated; some hairs of 'frayed' type. Antennae three-segmented, with first segment short, second about twice as long as first and bearing three long subapical setae and fairly long finger-shaped sensory cone, which is about as long as third antennal segment. Latter about as long as the first segment, with three long subapical setae and three to five short spines or sensory pegs apically. Postgenae ventrally separated by short gula.

*Mandibles* (Fig. 10W, Y)

Almost sickle-shaped and about twice as long as width at base; about half as long as cranium. Cutting edge bidentate (with one long apical and one smaller preapical tooth). Molar area without teeth but trenchant and bearing prostheca distally. Dorsal carinae rounded and indication of scrobis present, bearing long seta distally and shorter one some distance from base.

*Maxillae* (Fig. 10R)

Mala long and tapering with about six spicules or cones ventrally on mesal side near apex; lateral margin with short seta some distance from base and one on mesal side near base. Another short mesal seta situated about half-way between base and apex. Palpifer short and segment-like in some specimens and ventrally bearing short seta. Palpus three-segmented; first two segments of equal length, third longer; second segment with two lateral setae. Stipes ventrally with two setae. Sclerite between cardo and mala, bearing two short setae near base, which is raised and fairly convex dorsoventrally.

*Labium* (Fig. 10S)

Mentum small, membraneous and bearing four small setae on basal sclerotized area. Prementum bearing two segmented palpus and two setae on ventral side close to finger-shaped ligula, which is nearly as long as palpi. Prementum minutely setose near base of ligula, otherwise devoid of setae.

*Pupa* (Fig. 10Z)

Yellowish white in colour, becoming dark shortly before beetle emerges. Length 2,5–2,8 mm. Characterized by long setae: two on front, two on hind

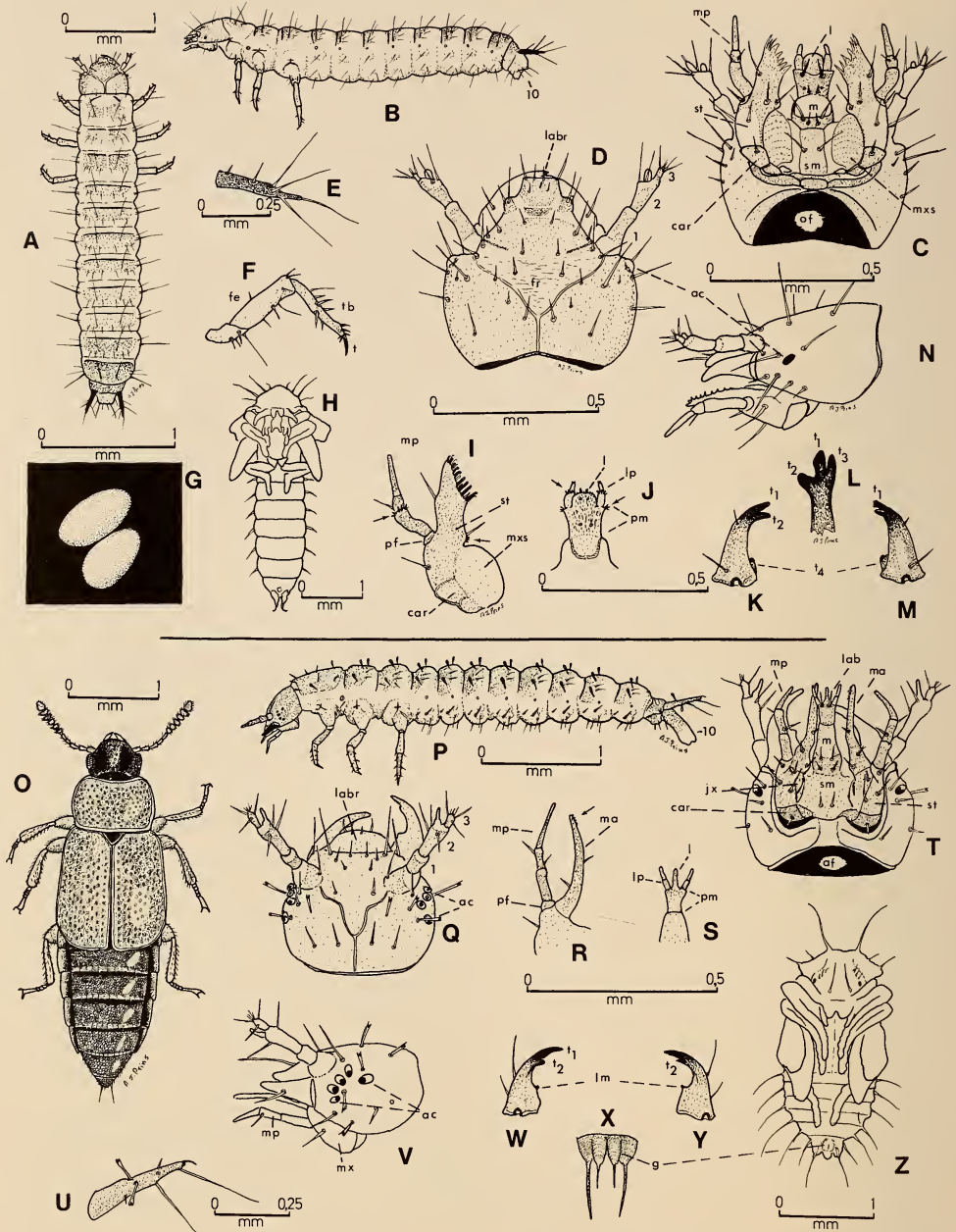


Fig. 10. Family Staphylinidae.

A-N. *Oxytelus caffer*. A. Larva (dorsal view). B. Larva (left lateral view). C. Head (ventral view). D. Head (dorsal view). E. Left urogomphus. F. Right mesothoracic leg. G. Eggs. H. Pupa (ventral view). I. Left maxilla (dorsal view). J. Labium (dorsal view). K. Left mandible (dorsal view). L. Apex of left mandible (lateral view). M. Right mandible (dorsal view). N. Head (left lateral view).

O-Z. *Omalius arenarium*. O. Adult. P. Larva (left lateral view). Q. Head (dorsal view). R. Left maxilla (dorsal view). S. Labium (dorsal view). T. Head (ventral view). U. Left urogomphus. V. Head (left lateral view). W. Left mandible (dorsal view). X. Apex of pupa (ventral view). Y. Right mandible (dorsal view). Z. Pupa (ventral view).



margin of pronotum and seven laterally, two submedially on abdominal terga 1-7. Also two long setae on front margin of head and some smaller ones on both head and pronotum and on abdominal sterna. First three abdominal spiracles circular and clearly visible, the others inconspicuous. Abdominal apex with two fleshy projections, each with a long seta; developing genital capsule either present as a rounded swelling or as two projections, each with short seta apically (Fig. 10X).

#### BIOLOGY

Larvae of this staphylinid were observed in decaying kelp along the west coast during the winter months. The larval period seems rather short and most larvae collected in June pupated during the same month. Most of the young larvae used for rearing of the adults were kept in decaying kelp from which all other arthropods were removed. These larvae developed to maturity and produced normal adults.

#### *Oxytelus caffer* (Erichson)

#### DESCRIPTION

##### *Adult* (Fig. 1C)

Black, matt or slightly shiny, particularly abdomen; strongly punctate and also rugulose, with rugulae more or less longitudinally arranged; areas between rugulae and punctures also minutely reticulate. Legs reddish brown. Easily recognized by presence of four longitudinal, rounded carinae over the middle of the pronotum. Length 3,2-4,2 mm.

One of the most numerous and widely spread staphylinids; according to Scheerpeltz (1973) it is distributed over a large area including South West Africa, South Africa and east Africa.

##### *Larva* (Fig. 10A-B)

Whitish yellow to lemon yellow, in some specimens even cadmium yellow in colour. About 7,0 mm long when full grown, subcylindrical and rather similar to that of *Aleochara* sp. Thoracic tergites divided medially by distinct line, but those of abdomen undivided. Anterior borders of all dorsal abdominal shields clearly demarcated by a thin, dark line. Thorax and abdomen sparsely covered with brownish hairs placed more or less in transverse rows; some of these hairs long, particularly those over middle of segments.

Ninth abdominal segment with two short piceous to blackish urogomphi (Fig. 10E), which appear undivided; each urogomphus with long apical seta, three long subapical setae, smaller seta about half-way between base and apex and small seta near base. Tenth segment forming short tube, with anal opening a short Y-shaped slit; stem of the Y pointing downwards and ending in pointed lobe. Abdominal spiracles circular and all more or less of the same size. Meso-

thoracic spiracles also circular, slightly larger than those on abdomen and also situated on side of body between pro- and mesothorax. Dorsal shield without any fine denticles; hairs simple.

Legs (Fig. 10F) as in *Aleochara* sp. with reduced number of spines. Tibia also with three spines around apex, one being dorsal; claws simple, acute and with two small spines placed ventrally near base.

*Head capsule* (Fig. 10C–D, N)

Pale golden brown with front one-third darker in older specimens; fairly smooth and shiny. Front transversely and finely rugulose; frontal and epicranial sutures rather indistinct in some specimens. Chaetotaxy as illustrated. Sides somewhat convex, hind margin widely and shallowly emarginate on dorsal side. One fairly large ocellus present on each side. Antennae appearing three-segmented; first segment about as long as second; latter with three long sub-apical setae and a large sensory cone on mesal side; third segment small, about as long as sensory cone, with three long preapical setae and about three short setae at apex. Neck absent. Labrum free, trapezoidal, and with rounded lobe on each side at base; also with almost triangular sclerite in middle at junction with clypeus. Frontoclypeal suture only partly developed on each side. Postgenae ventrally separated by small gula. Hind margin of cranium ventrally deeply emarginate.

*Mandibles* (Fig. 10K–M)

Narrow; broader basally and about twice longer than width at base. Fairly rounded dorsoventrally on external side, without dorsal carina. Long seta present near base (rather dorsally placed) and smaller seta (on external side) near base of apical teeth. Each mandible with three apical teeth although, when viewed from above, mandibles appear bidentate. Molar areas absent, but ventral side with oval, flat area bearing dorsal trenchant ridge which forms broad tooth ( $t_4$ ) on mesal side.

*Maxillae* (Fig. 10I)

Rather similar to those of *Aleochara* sp., but galea and lacinia not separated or delineated by suture. Mala oblique, almost trenchant, and furnished with eight to nine strong, palus-like teeth; basal teeth largest and extreme basal one in some specimens accompanied by one or two smaller ones. Basal half of mala ventrally also with three to four smaller teeth and apical part with five to six. Maxilla dorsally without setae, except for one long seta on lateral margin below palpus. Mesal margin of mala with few very small spines (or sensory pegs) near junction with maxillary articulating area. Maxilla ventrally with about four setae of which three are on apical half and one on basal half. Maxillary articulating area ventrally present as large convex lobe on mesal side of stipes. Cardo with one seta only on ventral side and with Y-shaped suture. Palpifer small and

bearing single seta ventrally. Palpus three-segmented, with first and apical segments of about equal length; first is shaped like wide S with a row of very small spine-like setae round its apex; second segment short, about half the length of first and with two ventral setae.

#### *Labium* (Fig. 10J)

Rather similar to that of *Aleochara* sp.; submentum fairly large and bearing two setae. Mentum wider than submentum and only partly sclerotized in young larvae; it bears four setae. Prementum with broad, lobe-like ligula and two-segmented palpi. As in maxillary palpi, first segment with row of tiny, spine-like setae or spicules on ventral side of its apex; apical segment with some sensory cones; also few tiny spines at base of first segment on palpiger. Stipes ventrally with two long setae as well as two short ones close to base. Labium dorsally beset with fine setae or spicules and two tiny, spine-like setae at apex of ligula. Four small circular sensory areas, two on ligula and two on stipes, clearly visible dorsally.

#### *Pupa* (Fig. 10H)

Oblong and light yellow in colour, but turns almost black just before emergence of beetle. Length 4,9–6,8 mm. Abdominal apex rather similar to that of *Xantholinus* sp. (Fig. 14L), with the developing genital capsule in most specimens visible as small conical tubercle just above two fleshy conical projections. First three abdominal spiracles circular, small and clearly visible; others inconspicuous. First abdominal tergum with two long submedian setae; second to seventh abdominal segments each with lateral setae. Head with three long setae on each side and two on occiput. Pronotum with two long setae on anterior margin and some long setae (about ten) along posterior and lateral margins. Otherwise devoid of setae.

#### BIOLOGY

Large numbers of the beetles were observed in cow-pats almost throughout the year and occurred in the wet as well as in the drier parts of the dung. Larvae and pupae were collected during autumn and winter and both larvae and beetles were found to feed on dung particles and on colloids oozing from the dung. Eggs (Fig. 10G) of this species are oval, smooth, and shiny, and are whitish yellow to bright lemon yellow in colour; those collected during June along the south coast measure  $0,68 \times 0,36$  mm to  $0,76 \times 0,46$  mm.

When full-grown, the larvae construct small oval cells in the soil or in the drier parts of the dung, in which the prepupae and pupae are formed. Pupal stages lasted 10–14 days in the laboratory during the winter months. Prepupae are somewhat wrinkled and pale yellow in colour. Newly emerged beetles are black with white wings, which darken after a few hours.



*Philonthus natalensis* Boheman

## DESCRIPTION

*Adult* (Fig. 11J)

Shiny black beetle, 11–12,5 mm long. Elytra short and covered with medium-long, golden-whitish hairs. Body microscopically striatoreticulate and with silky sheen; abdomen more shiny. Eyes large, oval, slightly less than twice as long as wide. Head smooth, except for row of large punctures around eyes and few postocular punctures, each bearing single long brown seta. Pronotum laterally with some long setae, particularly the transverse row parallel with anterior border on each shoulder; also about eight punctures on each side of the pronotal disc, each with long seta. Antennae brown, legs piceous with spines and hairs on tibiae and tarsi.

Widespread in east, south-east and South Africa (Scheerpeltz 1973).

*Larva* (Fig. 11A–B)

When mature, about 15,6 mm long. Head and pronotum dark reddish brown, meso- and metathorax yellowish brown with dark spot on each side; mesothorax darker in middle. Underside of thorax and abdomen creamy white; each tergum with two brownish sclerotized plates. Tenth abdominal segment long, tube-like and functioning as pseudopod. Cerci very long, inarticulate and about as long as first seven abdominal segments; basal ninth of each cercus beset with small spines, remainder of cercus with fine hairs; spine-like seta present dorsally near base of each cercus. Head slightly downwardly directed and about as wide as thorax. Pronotum narrower in front than behind and with shallow, oblique, more weakly sclerotized depression on each side near anterior angles. Sclerotized areas fairly smooth and shiny.

Body sparsely covered with long golden brown setae, some of which of 'frayed' type (Fig. 11L) with branched tips. Body integument dorsally with microscopic triangular denticles, visible only under high magnification. Ecdysial suture visible as pale reddish-yellow longitudinal line over the middle of thoracic terga, anteriorly continuous with epicranial stem. Sterna similar to those of *Staphylinus* sp., but most setae of 'frayed' type. Mesonotal spiracle large, oval, and with single seta anteriorly. Abdominal spiracles almost circular, those of first abdominal segment larger.

Only coxae and femora with some short, fine hairs (Fig. 11E), otherwise legs devoid of hairs, but with strong spines or spine-like setae; those on femora arranged in double ventral row; space between rows bare. Each trochanter with six to seven ventral spines, and long slender apical seta. Tibiae with spines distributed over whole surface. Claws as in *Staphylinus* sp. (Fig. 13F), but each one with three short spines, one of which is ventral, the other two situated more or less on posterior side.

The larvae are characteristic of the genus *Philonthus* and easily recognized by their very long cerci.

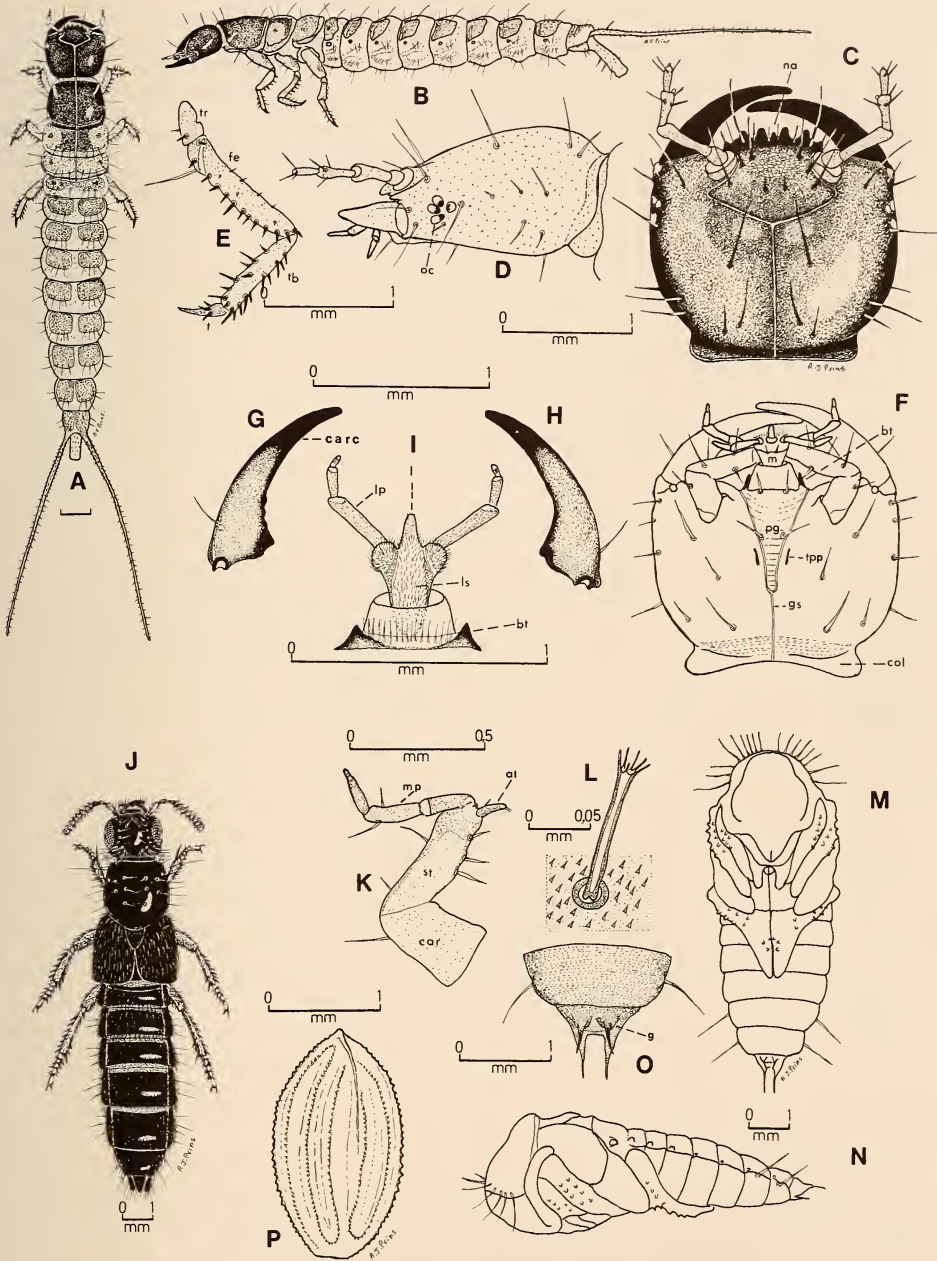


Fig. 11. Family Staphylinidae.

*Philonthus natalensis*. A. Larva (dorsal view). B. Larva (left lateral view). C. Head (dorsal view). D. Head (left lateral view). E. Right leg (posterior view). F. Head (ventral view). G. Left mandible (dorsal view). H. Right mandible (dorsal view). I. Labium (dorsal view). J. Adult. K. Left maxilla (dorsal view). L. Modified seta and triangular denticles on integument (highly magnified). M. Pupa (ventral view). N. Pupa (left lateral view). O. Ventral view of last two abdominal segments of pupa. P. Egg.

*Head capsule* (Fig. 11C–D, F)

Dark yellowish brown, fairly smooth and shiny. Sides almost parallel, posterior corners rounded. Long epicranial stem and shorter frontal sutures visible as thin pale-reddish lines. Neck short. Chaetotaxy as illustrated. Four ocelli present. Cheeks rounded dorsoventrally and without carinae. Frons small, with two setae on each side. Each half of epicranium bearing only about eight dorsal setae and only faint indication of paler longitudinal lines. Nasale shaped as in *Staphylinus* sp., septemdentate and with same number of setae.

Ventral aspect of cranium very similar to that of *Staphylinus* sp.; pregula, however, much longer and more acute posteriorly and with same number of setae. Posterior tentorial pits visible as short, elongate black marks laterad to arms of gular suture, not adjacent to stem as in *Staphylinus* sp. Antennae four-segmented, with one sensory cone on apex of fourth segment and one mesally near apex of penultimate segment; latter and apical segment with pre-apical setae.

*Mandibles* (Fig. 11G–H)

Almost falcate, slightly less than half the length of cranium. Retinaculum absent; each mandible with dorsal carina on cutting edge extending over apical two-thirds of its length. Apices of both mandibles rounded, not pointed as in *Staphylinus* sp. Lateral side of mandible rounded, without carina, and with single fairly long seta near base. Molar areas and penicilli absent.

*Maxillae* (Fig. 11K)

Similar to those of *Staphylinus* sp. Stipes fairly long, both ventral and dorsal faces devoid of setae, except for single long seta ventrally near base and inconspicuous seta on base of palp; also two setae on lateral margin, one of which is fairly long, and about four setae on mesal side (mala). Inner lobes absent, outer lobes or galea conical and about as long as penultimate segment of labial palp and bearing two setae at apex as well as single short seta near base. Maxillary palps appear three-segmented, with apical and penultimate segments of about equal length, latter with single lateral and mesal seta; terminal segment with apical third narrowed. Palpifer with single seta as in *Staphylinus* sp. Cardo long, about three-quarters length of stipes and bearing single ventral seta.

*Labium* (Fig. 11I)

Ligula conical as in *Staphylinus* sp. and nearly as long as penultimate segment of palp. Latter three-segmented, with first segment about twice as long as penultimate one, apical segment less than half the length of latter. As in *Staphylinus* sp., prementum can be retracted into mentum and bears ventral seta near each palpal base. Labial stipes, including palpigers, dorsally covered with fine silky hairs as in *Staphylinus* sp. Mentum on each side with tooth, as in latter species.



*Pupa* (Fig. 11M–O)

Semi-obtect, almost smooth and shiny and very similar to that of *Staphylinus* sp. Light reddish yellow in colour. Length 7,9–8,7 mm. Anterior pronotal margin with sixteen to twenty long barbed setae and lateral margins of abdominal segments 7 and 8 also with fairly long setae. Spiracles as in *Staphylinus* sp. All legs with six to nine pointed tubercles. It differs from pupa of *Staphylinus* in possessing two conical projections at posterior end, each with an elongate seta-like filament. Developing genital capsule (Fig. 11O) also represented by two spine-like projections apically on ventral side.

## BIOLOGY

The oval, almost pure-white eggs (Fig. 11P) are fairly large, about 2,2 mm long and about 1,4 mm wide, matt and with indistinct striae and longitudinal tuberculate ridges alternately arranged, as illustrated. They were laid singly in semi-fresh dung during October and hatched in 4 or 5 days. On hatching the chorion splits from the top over one or both sides and just before hatching the mandibles of the larva can be seen in the middle of the egg on one side.

The newly hatched larva looks very much like the mature larva, but is pure white with golden-brown mandibles and four brownish eyes on each side of the head. It measures about 6,1 mm in length shortly after hatching and its long cerci are about as long as the almost transparent body. The spiracles are very conspicuous at this stage and in most of the specimens examined there are only a few setae on the body and most of these, even some of the spines on the legs (except a few on the head, thorax and ventral side of the 8th abdominal segment), are of the 'frayed' type. The claws are conspicuous and bear only two ventral spines. The tenth segment is very large in relation to the rest of the body and is about as long as the head. In the latter the coronal and frontal sutures are obsolete and the two small setae on the middle of the frontal disc, as well as the two posterior setae near the posterior border of the head, are absent. The mandibles are fairly pointed, and the small apical part of the third segment of the maxillary palp is already differentiated. After a few hours the larva becomes greyish in colour, but the first two body segments as well as the head are golden brown.

The lifespan of the larva is short and those reared in the laboratory were mature in about 14 days at 25°–27°C after which they pupated in their larval skins in small clay cells either in the soil or in the remains of the dung. Hafez (1939a) gives the duration of the larval stage of the cosmopolitan *Philonthus quisquiliarius* (Gyllenhal) in Cairo as 6 to 8 days at 30°C. Pupae were recovered during November and the adult beetles emerged after about 9 days. The newly emerged beetles are black with almost pure-white wings and elytra.

This species was very abundant in fresh cow-dung along the south coast. Both larvae and adults are predacious on other insects and also feed on the juices oozing from the dung.

*Philonthus* spp.

(Fig. 1B)

Two forms of this beetle were collected in cow-dung. The one (sp. A) is somewhat larger than the other (sp. B) and was collected mostly along the south coast; sp. B was found throughout the area surveyed. As a proper identification of the two forms was impossible, they are here treated as two separate species; however, there are no appreciable morphological differences between the larvae.

*Philonthus* sp. A (large)

## DESCRIPTION

*Adult*

Similar to *P. natalensis* but smaller, only 7,5–7,9 mm long; colour black, head and pronotum very shiny. Head narrower than in latter species and more oval in shape.

This species was found in association with *P. natalensis* and is apparently widely spread along the south coast; it was also observed at Montagu.

*Larva* (Fig. 12A)

Rather similar to that of *P. natalensis* but smaller, measuring only 10–12 mm in length when mature, and cerci (Fig. 12L) much shorter, consisting of two segments. Second segment of cercus slightly less than half the length of first and with long apical seta, as well as small subapical, spine-like seta; first segment with about six long setae as well as some shorter ones. Tenth abdominal segment tube-like, but shorter than in *P. natalensis*. Whole body sparsely covered with medium-long brownish setae, some of which are of 'frayed' type (Fig. 12B). Otherwise exactly as in *P. natalensis*. The dorsal integument covered with denticles similar to those of *P. natalensis*, but somewhat larger. Spiracles similar to those of *P. natalensis*, including anteriorly situated seta on mesothoracic pair. Legs also similar to those of *P. natalensis*, including tarsal spines and long seta on apical portion of trochanter.

*Head capsule* (Fig. 12C–D)

Light brown to yellowish brown in colour; very finely reticulate and with some rugae; smooth and shiny, about as long as wide, with sides parallel and hind margin almost straight. Neck as in *P. natalensis*, posterior angles rounded. Nasale, ocelli antennae and ecdysial sutures as in *P. natalensis*. Ventral aspect of cranium also very similar. Chaetotaxy as in Figure 12C–D.

*Mandibles*

Similar to those of *P. natalensis* and much shorter than cranium; also bearing seta close to base.

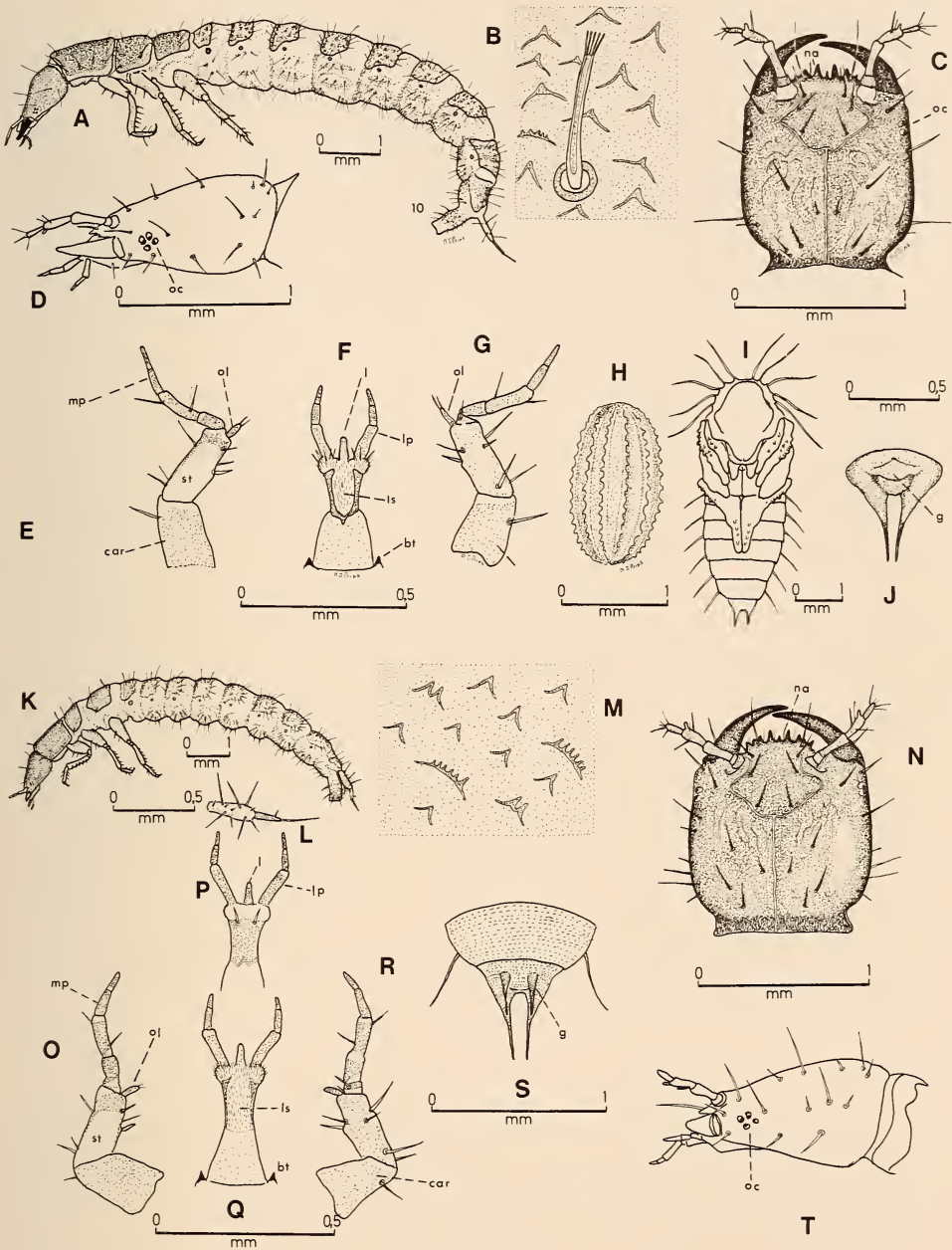


Fig. 12. Family Staphylinidae.

A-J. *Philonthus* sp. A (large). A. Larva (left lateral view). B. Integument of dorsal shield, showing hair and denticles (highly magnified). C. Head (dorsal view). D. Head (left lateral view). E. Left maxilla (dorsal view). F. Labium (dorsal view). G. Left maxilla (ventral view). H. Egg. I. Pupa (ventral view). J. Abdominal apex of pupa (ventral view).  
 K-T. *Philonthus* sp. B (small). K. Larva (left lateral view). L. Urogomphus. M. Integument of dorsal shield (highly magnified). N. Head (dorsal view). O. Left maxilla (dorsal view). P. Labium (ventral view). Q. Labium (dorsal view). R. Left maxilla (ventral view). S. Abdominal apex of pupa (ventral view). T. Head (left lateral view).



*Maxillae* (Fig. 12E, G)

Very similar to those of *P. natalensis*. However, maxillary palpi clearly four-segmented, tapering towards apex, with apical and first segments of about equal size; second segment slightly less than twice as long as first, and third segment slightly longer than apical one; only second segment with two setae. Inner lobes absent, outer lobes present as finger-like structure, about as long as first palpal segment and bearing two to three setae at apex. Otherwise as in *P. natalensis*. Stipes with only one spine-like seta mesally and two on lateral side; ventrally with three setae and dorsally either with one near mesal margin or without any setae. Cardo as in *P. natalensis*. Palpifer also with single seta.

*Labium* (Fig. 12F)

Ligula finger-shaped and conical, almost as in *P. natalensis*, and about as long as penultimate segment of three-segmented palp. First segment of palpus long, about twice as long as the second. Sides of ligular stipes (prementum) sclerotized, median area beset with fine hairs dorsally, as in *P. natalensis*; palpigers not as convex as in latter. Labium ventrally with two submedian setae on posterior boundary of palpigers (Fig. 12P), exactly as in *P. natalensis*; also with tooth on each side of mentum.

*Pupa* (Fig. 12I-J)

Very similar to that of *P. natalensis* but smaller, only 4,8-5 mm in length. Colour pale whitish yellow, but becoming piceous just before beetle emerges. Differs from pupa of *P. natalensis* in that setae on anterior margin of pronotum are much longer in relation to body; there are furthermore only five to six setae on each side, compared with eight to eleven in *P. natalensis*. In most specimens examined, developing genital capsule (Fig. 12J) appeared as a flat lobe flush with body wall and, except in few cases, the two spine-like projections were absent. Every abdominal segment with medium-long seta laterally, whereas in *P. natalensis* only segments 7 and 8 bear lateral setae.

## BIOLOGY

The eggs (Fig. 12H) of this species are very similar to those of *P. natalensis* but are smaller, measuring about 1,5 mm by 0,96 mm and the tubercles or dentations on the ridges are larger; the colour of most of the eggs was dirty white. They were laid singly in fresh dung at the same time as those of *P. natalensis*. The larval lifespan is more or less the same as in *P. natalensis* and pupae appeared during November. As in the latter species, the larvae construct clay cells in the soil in which they pupate. Most of the larvae were reared in fresh dung that did not contain any arthropods, except for mites and a few sciarid larvae; when crowded they became cannibalistic.

*Philonthus* sp. B (small)

## DESCRIPTION

*Adult*

Black, head and pronotum smooth and very shiny. Elytra brownish black and densely setose. Abdomen shiny and densely covered with setae. Similar to sp. A except for size: most specimens collected measure only 3,7–5,3 mm.

This is one of the most common rove-beetles in cow-dung and was observed in all the areas surveyed.

*Larva* (Fig. 12K)

Very similar to sp. A in general form, setal pattern and colour, but somewhat smaller, mature larvae measuring 9–10 mm. Spiracles and legs similar to those of sp. A, including long seta on apical portion of trochanters and anteriorly situated seta on mesothoracic spiracles. Dorsal shields with triangular teeth as in sp. A; some of the teeth broad and tri- or multidentate as in sp. A (Fig. 12M) and to some extent also in *P. natalensis*. Body setae of 'frayed' type as in other species.

*Head capsule* (Fig. 12N, T)

Very similar to that of sp. A; however, nasale somewhat more produced in front. Colour golden brown. Almost smooth and shiny, very finely reticulate and with some rugae, particularly near the frons. About as long as wide or slightly wider than long in some specimens. Chaetotaxy as in Figure 12N, T. Ventral aspect similar to that of sp. A. Antennae as in latter and also four-segmented.

*Mandibles, maxillae* (Fig. 12O, R), and *labium* (Fig. 12P, Q)

Exactly as in sp. A.

*Pupa*

Similar to sp. A but smaller, varying from 3,8 to 4,5 mm in length and most specimens collected have the two spine-like projections present (Fig. 12S).

## BIOLOGY

Beetles and larvae were found breeding in semi-fresh cow-dung throughout the summer and autumn and the larval lifespan seems to be the same as for sp. A. In both cases the larvae construct loose cells in the soil in which they remain dormant for a short while; the pupal stage in sp. B lasts about 6 days in January.

*Staphylinus* sp.

## DESCRIPTION

*Adult* (Fig. 13M)

Large, beautiful, and aggressive species, 15,8–17 mm long, densely covered with fine, silky, golden-brown hairs, which give it a chequered appearance. True

colour of body dark brown, except elytra, borders of prothorax and apical margins of segments, which are brownish red. Densely punctate and dull all over, except for a narrow longitudinal, smooth and shiny line over middle of pronotum. Coloration of anterior border of cranium, including a V-shaped area in middle of anterior border and basal part of labrum, reddish yellow. A narrow area around the eyes, extending nearly to the posterior border of the head as well as the clypeus, also reddish yellow. Labrum deeply cleft in middle. Antennae and legs pale yellowish brown.

Distributed throughout the interior of the southern and south-western parts of South Africa where the surveys were made.

*Larva* (Fig. 13A–B)

Length 23–24 mm when mature. In general shape very similar to the larva of *Laemostenus complanatus*, but head is carried horizontally, with mandibles directed slightly downward. Head and pronotal shield dark reddish brown, head almost piceous in old larvae; meso-, and metathoracic and first abdominal tergum light brown. Thoracic terga with thin, white median line (ecdysial suture), which is anteriorly continuous with epicranial stem. Head as wide as, or slightly wider than, pronotum and in mature specimens examined it measured 4 mm long, including closed mandibles. Legs and antennae pale brownish yellow.

Abdomen creamy white and tergal plates only slightly demarcated on segments 3–9. Second abdominal segment with tergum almost as strongly sclerotized as first. Each abdominal sternum with two sclerotized plates bearing setae, of which at least some are of 'frayed' type; plates rather obscure, except on first abdominal segment, which has two smaller, clearly demarcated plates with about five setae each. Body integument dorsally with microscopic, triangular denticles similar to those of *Philonthus natalensis*. Cerci same colour as abdomen and fairly long. Tenth segment tubular, almost as long as eighth and functions as proleg. Spiracles oval, with mesothoracic pair (Fig. 13D) largest and with strong seta anteriorly; those on first abdominal segment (Fig. 13E) larger than other abdominal spiracles. Inner surface of each spiracle lined with fine, microscopic hairs. Some setae on abdomen with branched tips. Each cercus (Fig. 13H) with six long setae, of which one is situated apically; also six to eight short 'frayed' setae at base of each cercus. Latter appears two-segmented, with apical segment thin, nearly half the length of first, and situated on short segment-like extension of first.

Legs (Fig. 13F) yellowish brown. Tarsungulus simple, acute and about half the length of tibia, bearing two small setae on ventral side, about half-way between its base and apex. All segments except the coxae with strong, almost palus-like setae or spines. Femur on each side with lateroventral row of spines, which meet at apex; ventral area between rows with short basal row of three spines; laterally also with row of finer setae above the spines and with few small scattered dorsal setae; otherwise its dorsum devoid of hairs. Spines on tibia



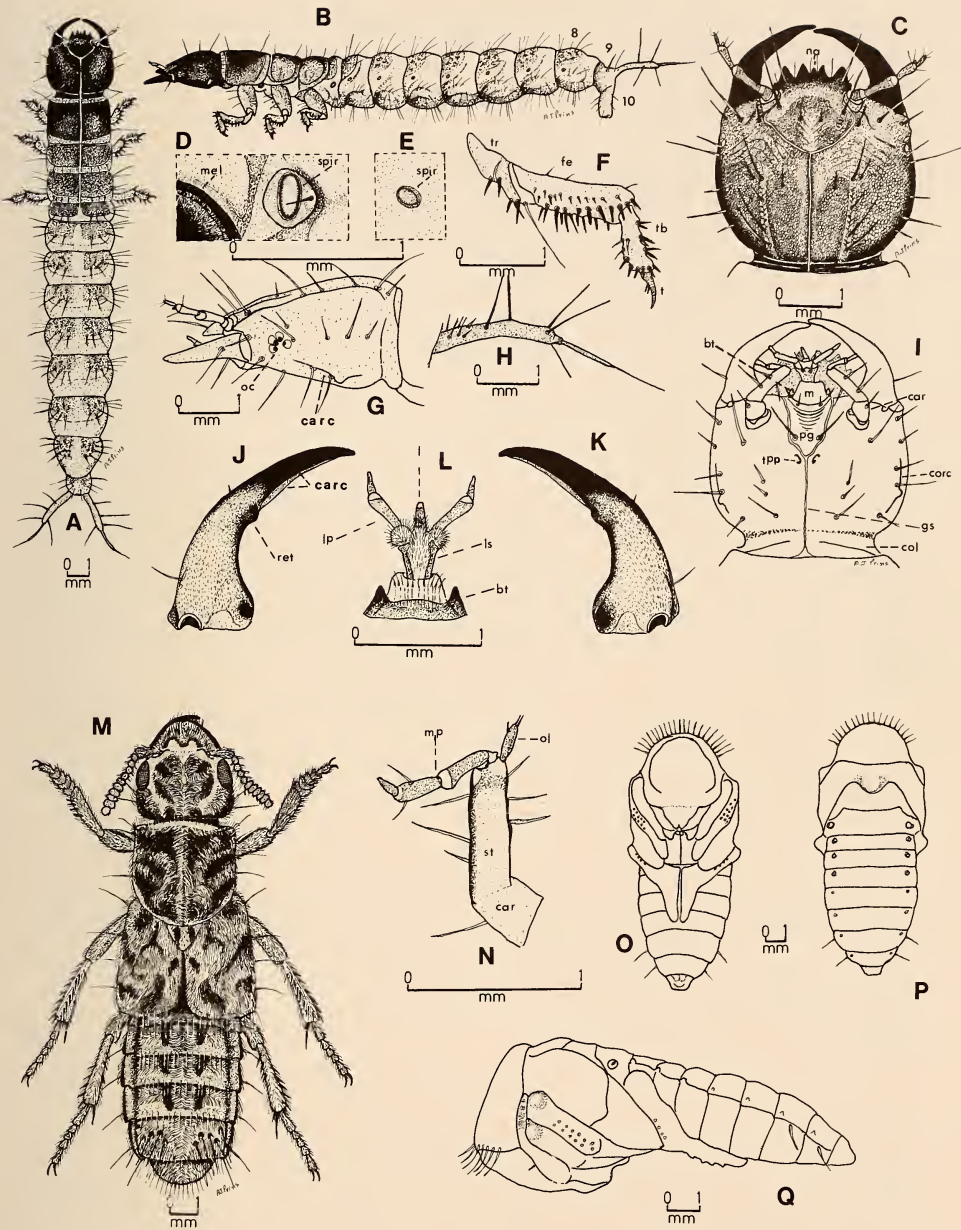


Fig. 13. Family Staphylinidae.

*Staphylinus* sp. A. Larva (dorsal view). B. Larva (left lateral view). C. Head (dorsal view). D. Right mesothoracic spiracle. E. Right abdominal spiracle. F. Right mesothoracic leg. G. Head (left lateral view). H. Urogomphus. I. Head (ventral view). J. Left mandible (dorsal view). K. Right mandible (dorsal view). L. Labium (dorsal view). M. Adult. N. Left maxilla (dorsal view). O. Pupa (ventral view). P. Pupa (dorsal view). Q. Pupa (left lateral view).

similarly arranged, but with only two spines on ventral area between rows. Trochanters with about twelve strong setae, situated ventrally and laterally; apical one very long.

*Head capsule* (Fig. 13C, G, I)

About as long as wide, or slightly wider than long. Sutures distinct; epicranial stem long, frontal sutures enclosing small frons. Dark reddish brown in colour. Distal half of cranium and largest part of frons microscopically reticulate; basal half more or less smooth, very superficially reticulate and also with some rugulosity. Whole head somewhat shiny, particularly front half. Chaetotaxy as in illustration. Epicranium on each side with narrow, smooth longitudinal area divided by fine, branched stria; each area with about four setae. Nasale septemdentate, median and lateral teeth small. Intervening spaces between teeth each with short seta; long seta present on each large lateral tooth, and shorter one posteromesad of latter.

Four-segmented antennae situated on each side of nasale. Second antennal segment largest, more than twice as long as first; fourth segment small and about half the length of third; latter with sensory cone on the mesal side; fourth segment with sensory cone at apex. Both penultimate and apical segments with three setae, two on mesal side in penultimate segment and one on mesal side in apical segment.

Four ocelli on each side. Gular suture distinct and Y-shaped, enclosing a narrow pregula; tentorial pits situated just behind latter. Collum short, but distinct. Cranium on each side with weak carina, which ends posteriorly in tooth-like tubercle.

*Mandibles* (Fig. 13J-K)

Falcate, about half the length of cranium and almost symmetrical. Cutting edge with uninterrupted dorsal and ventral carina and with indication of dorsal tooth or retinaculum half-way between apex and base. Molar areas and penicilli absent. Single, medium-long seta present near base on external margin and minute one opposite dorsal tooth.

*Maxillae* (Fig. 13N)

Stipes long and devoid of setae ventrally and dorsally, except for two short setae, one on inconspicuous base of three-segmented palp and one on apex of stipes. Mesal and lateral margins both with four setae. Cardo with a single long seta on lateral margin. Inner lobes of maxillae absent; outer lobes one-segmented, conical and slightly less than twice as long as apical segment of palp, and with two apical setae; also with small seta on apical half of lateral margin. First two segments of palp about equal in length, apical one about half the length of penultimate one; latter with single lateral seta on each side. Palpifer segment-like and small, less than half the length of first palpal segment.

*Labium* (Fig. 13L)

Ligula conical, elongate and one-segmented. Palpi two-segmented; apical segment shorter than ligula and nearly half the length of basal segment. Labial stipes (prementum, with ventral seta near palpal bases) can be retracted into mentum. Pointed tooth present on hypopharyngeal bracon on each side of mentum at base of which is short ventral seta. Mentum basally also with two ventral setae. Labium dorsally with fine, silky hairs on its base and on stipes, extending forward to base of ligula and also covering bases of palpi.

*Pupa* (Fig. 13O–Q)

Semi-obtect, almost smooth and shiny, heavily sclerotized, orange-brown, and about 12,5 mm long. Body devoid of setae, except for row of about twenty-one barbed setae on anterior margin of pronotum and single barbed seta on lateral sides of segments 7 and 8. Each mesothoracic leg with about sixteen small tubercles and each metathoracic leg with about five. Median area of mesonotum immediately anterior to M-shaped suture and upper boundaries of legs swollen and somewhat conical. First four spiracles on each side conical and conspicuous, last four small and inconspicuous. Labrum narrowly but acutely excised in middle, with short suture extending from emargination. Developing genital capsule indicated only by two almost flat areas (each with tiny depression) on ventral side of apical segment. Pupa darkens after a few days and four small black spots (eyes) become visible on each side of head.

## BIOLOGY

Young larvae were collected under semi-fresh cow-pats from April to August and pupation took place from July to September. The larval stages lasted for 100–140 days and the pupal stages at least 35 days. Most of the pupae were found in small clay cells in the soil, but a few were found in cells hollowed out in cow-pats lying on fairly dry and hard soil. The larvae collected fed mostly on larvae of the dung fly, *Orthellia peronii* (Robineau-Desvoidy).

Large, oval, creamy-white eggs measuring about 2,9 mm by 2,5 mm, with the surface densely covered with microscopic spinules or tubercles, and found in dung containing its larvae, apparently belong to this species. The eggs very closely resemble those of some of the larger scarabs.

*Xantholinus* sp.

## DESCRIPTION

*Adult* (Fig. 14A)

Dark blackish brown to almost black in colour, with apical part of elytra brownish. Very finely reticulate-rugulose, fairly shiny and sparsely punctured with fairly large oblong punctures on head, thorax, and elytra. Covered with medium-long golden hairs. Eyes large, situated near anterior margin of head. Mandibles, legs, and antennal flagellum reddish brown. Length 6,3–7,5 mm.



Widely distributed in the southern Cape Province, having been observed in carcasses around Cape Town and in semi-fresh to fresh cow-pats along the south coast.

*Larva* (Fig. 14B)

Mature larvae measure about 7,8 mm and are creamy white, except for head and pronotum, which are light reddish brown or brownish red, and meso- and metanotum and legs, which are pale yellowish red. Sparsely covered with medium-long brownish hairs more or less arranged in two transverse rows on tergites. Urogomphi (Fig. 14D) shorter than the tubular tenth segment and two-segmented; the terminal segment thin and with long apical seta. Spiracles oval; meso-thoracic one transverse (Fig. 14F) and with seta anterior to it; those on abdominal segments obliquely arranged; first abdominal and mesothoracic spiracle of about equal size and larger than rest. Legs (Fig. 14E) similar to those of *Philonthus* spp., but spines somewhat longer; trochanter also with a long seta anteriorly; claws acute and with only two spines more or less on ventral side. Median longitudinal line (ecdysial suture) over thorax distinct, anteriorly continuous with epicranial stem. Tergites on abdominal segments divided medially by fairly broad longitudinal line. Dorsal integument without triangular denticles, but in some places with long rows of fine spicules (Fig. 14G). Setae and spines simple.

*Head capsule* (Fig. 14C, H-I)

About as wide as pronotum, sides almost parallel and somewhat sinuate; posterior corners rounded and posterior margin almost straight. Golden brown to light brownish red in colour, almost smooth and shiny; anterior half rugose in middle and also finely reticulate between rugae; posterior half faintly rugulose. Nasale prolonged in front and consisting of median lobe with three teeth, of which middle one is smallest, and two lateral lobes, each with four teeth of about equal size. Chaetotaxy as illustrated. Frontal and epicranial sutures as in *Philonthus* spp. Neck fairly wide. Antennae appear four-segmented, with basal segment small, much shorter than second; the latter and third antennal segments of about equal size; apical segment with three long subapical setae and about three smaller setae at apex; slightly shorter than third segment, the latter with three long subapical setae and a long sensory cone on the ventral side close to apical border. Single ocellus present on each side. Gular suture Y-shaped and anteriorly enclosing fairly wide pregula, beset with numerous small, rounded tubercles.

*Mandibles* (Fig. 14N)

Falcate and much shorter than cranium; lateral side rounded, without dorsal carina and with three lateral setae, of which basal one is smallest. Molar area absent but small denticle, reminiscent of prostheca, is present. Cutting edge pointed apically and with dorsal trenchant ridge running from apex to about half the length of mandible.

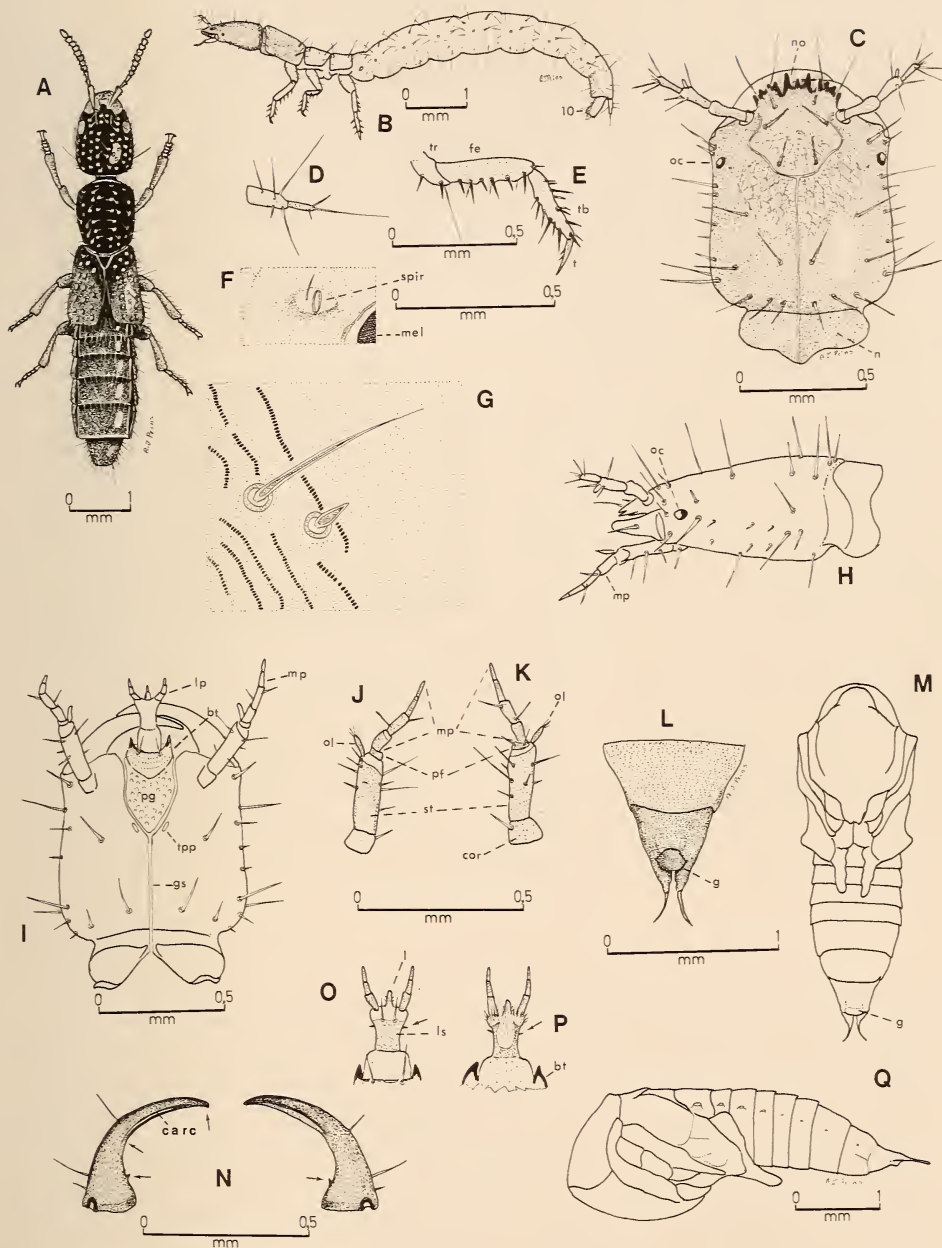


Fig. 14. Family Staphylinidae.

*Xantholinus* sp. A. Adult. B. Larva (left lateral view). C. Head (dorsal view). D. Left urogomphus. E. Right mesothoracic leg. F. Light mesothoracic spiracle. G. Integument of dorsal shield of abdomen (highly magnified). H. Head (left lateral view). I. Head (ventral view). J. Left maxilla (dorsal view). K. Left maxilla (ventral view). L. Last two abdominal segments of pupa (ventral view). M. Pupa (ventral view). N. Left and right mandible (dorsal view). O. Labium (ventral view). P. Labium (dorsal view). Q. Pupa (left lateral view).

*Maxillae* (Fig. 14J–K)

Similar to that of *Philonthus natalensis*, but maxillary palp clearly four-segmented, with segments tapering towards apex; second segment with two lateral setae of which one is mesal. Palpifer segment-like and bearing two setae ventrally. Stipes long, ventrolaterally with about six setae and with another seta almost in middle of stipes. Cardo ventrally also with one long seta situated more to mesal side. Stipes and cardo dorsally without setae, except for short one situated laterally just below outer lobe and in some specimens second one just below first. Outer lobe finger-like, nearly as long as second palpal segment and bearing about three apical setae.

*Labium* (Fig. 14O–P)

Very similar to that of *P. natalensis* and with three-segmented palpi. Ligula conical and beset with fine hairs dorsally (including also the palpigers and median area). Palps tapering towards apex; first segment longest and apical one shortest; tiny spine present laterally just below palpiger.

*Pupa* (Fig. 14L–M, Q)

Semi-obtect. Newly formed pupae are white but soon turn to a whitish yellow with the posterior projections brownish red and mandibles red-brown. Length 3.9–4.8 mm. Very finely reticulate-punctate, shiny and without any setae, except two diverging, seta-like filaments borne on two conical caudal projections.

Pupae rather similar to those of *Philonthus natalensis* except for absence of hairs. Developing genital capsule (Fig. 14L) appears as a raised or somewhat conical area ventrally on abdominal apex. First four abdominal spiracles fairly large and clearly demarcated, diminishing in size posteriorly; remainder very indistinct.

## BIOLOGY

Larvae of this species were found in carcasses in Cape Town from September to October; they were feeding mainly on fly larvae, especially those of the cheese-skipper, *Piophilha megastigmata* McAlpine. The duration of the larval period was approximately 19 days. Mature larvae construct oval clay cells, measuring 7–7.5 mm in length, in the soil for pupation. In most cases there was a prepupal stage of 3–4 days, during which time the larvae became almost pure white, except for the reddish head. The pupal stage lasted 11–14 days in November. Larvae collected in decaying cow-dung from June to August had a somewhat longer lifespan, the pupal period being 20–22 days.

Newly emerged beetles are blackish with pure white wings, which usually become blackish within 4–6 days. Some of the beetles were found to feed on cheese-skipper maggots, but small grubs of skin-and-hide beetles were also attacked; in the laboratory even some of the large white collembolans were devoured.



### Family Silphidae

Small to moderately large (about 40 mm) flattened beetles, usually sombre coloured, often with metallic blue sheen; some with red or orange markings. Apical abdominal segments often exposed. Antennae ten- to eleven-segmented. Tarsal formula 5-5-5. Most of them are carrion feeders, both in the adult and larval form; some feed on snails and lepidopterous larvae and a few are phytophagous (not present in South Africa). Species of the genus *Nicrophorus* (not occurring in southern Africa) have the habit of burying the carrion to ensure an adequate food-supply for the larvae; they are therefore known as burying beetles.

Only about ten species have been described from the Subsaharan region, of which the endemic *Silpha mutilata* Laporte & Castelnau and the more widespread *S. micans* Fabricius have been introduced into Europe. The latter, together with *S. caeruleoviridans* Dohrn (also widely distributed in the Cape Province, South West Africa and Zimbabwe), were described under the subgenus *Chalcosilpha*; however, according to Arrow (1909) these two species are conspecific. The largest species found in the Cape Province are *S. capicola* Péringuey, *S. peringueyi* Portevin, and *S. punctulata* Olivier (which is common in fynbos along the western parts of the southern Cape), all measuring 17 to 20 mm in length.

Both *S. micans* and *S. mutilata* (which differs from the first-mentioned species by the small elevated area or ridge in the middle of each elytron) (Fig. 2F) were found to be common on carcasses of mammals and birds both on the coast and inland, and were also attracted to soil containing decomposing fish-meal. However, only the one species, *S. micans*, was observed to breed in this medium and in the carcasses examined.

#### *Silpha micans* Fabricius

##### DESCRIPTION

##### *Adult* (Fig. 15A)

Elytra blackish to blackish brown with rest of body, including legs and antennae, blackish blue, in some cases even iridescent blue; legs perhaps more bluish brown; eyes black. Integument leathery, elytra not covering three to four terminal abdominal segments. Each elytron with three almost indistinct longitudinal rugae, of which the exterior one is the most prominent and reaches only to about the posterior one-third of the wing cover. Tibiae with numerous spines. Wings well developed. Antennae with three-segmented club. All tarsi five-segmented. Length 12,6-13,8 mm.

Widely spread in the Subsaharan region (Jeannel & Hatch 1928).

##### *Larva* (Fig. 15C)

General description of the larva of a *Silpha* sp. is given by Dorsey (1940). Depressed dorsoventrally and wider in front than behind. Thoracic terga rounded laterally. Abdominal terga, except ninth and tenth, with anterolateral angles

rounded, posterolateral angles acute, and lateral and posterior borders furnished with setae, some of which (particularly lateral ones) are more strongly developed. Head narrower in front than behind; nearly cordiform. Nine pairs of spiracles situated ventrally, with mesothoracic one largest; first abdominal pair somewhat larger than the other abdominal spiracles; all oval or annular; mesothoracic pair (Fig. 15P) furnished with two setae each, situated on internal side. Colour dark brown to blackish brown, particularly posterior third of each segment. Integument leathery and covered with small tubercles and medium-long setae (Fig. 15S) most of which are cleft at tip, or even cleft two or three times. Sculpture on thoracic terga present as wide, irregular reticulation, particularly on the anterior part of the pronotum. Ecdysial suture distinct in most segments, except perhaps last two or three. Tenth abdominal segment almost tubular, about as long as ninth and tapering towards apex; ninth fringed with fine setae.

Legs (Fig. 15H) well developed, slightly increasing in size from hind legs to forelegs; coxae large, with longitudinal groove on exterior face distinct; strong spine-like setae present, both ventrally and dorsally on tibiae, ventrally only on femora; dorsal setae on latter short but slender; tarsungulus acute and with one ventral and one posterior spine about half-way between base and apex. Urogomphi borne on ninth abdominal segment; fairly long, appearing two-segmented, with first segment much longer than terminal one and furnished with spine-like setae; latter segment subdivided into a smaller proximal and larger distal part in some specimens; with one or two pre-apical setae and with a medium-long seta apically. Mature larvae measure about 14 mm in length.

#### *Head capsule* (Fig. 15E-G)

Slightly less than twice as wide as long. Sides very convex, epistomal and frontal sutures clearly indicated. Distal ends of dorsal tentorial arms, although contiguous with frontal sutures, are not in line with antennal sockets as stated by Dorsey (1940) but further back, more or less in line with dorsal ocelli. Latter four in number and situated on lateral margin, about half-way between base and apex. Ventral ocelli two in number, with anterior one situated just below antennal socket. Frontoclypeal suture indicated only laterally, obsolete over middle portion. Posterior margin of head widely and shallowly emarginate dorsally. Antennae three-segmented, with first and apical segments of about equal length, second one somewhat longer and bearing projection on mesal part of its apex. Last two segments with setae. Chaetotaxy of head in most cases as illustrated. Sculpture consisting of small tubercles arranged in form of a wide reticulation, areas between striae minutely reticulate and shiny. Frons more rugulose, with reduced number of tubercles. Head divided ventrally into two halves by deep, emarginate hind border; gula short.

#### *Labrum and clypeus*

Labrum and clypeus united, almost triangular; boundary between them indicated by more weakly sclerotized cuticle. Labrum more or less smooth, with

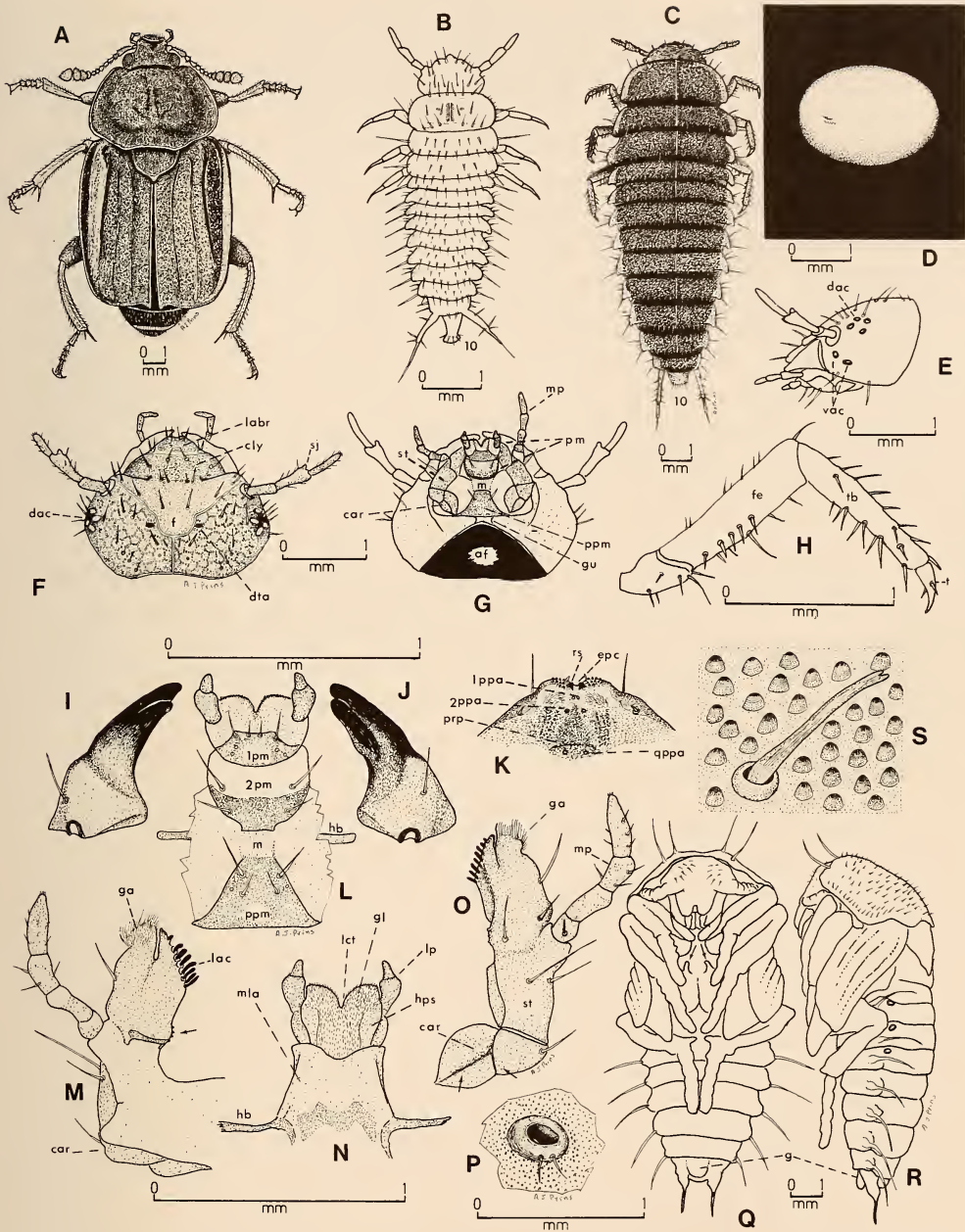


Fig. 15. Family Silphidae.

*Silpha micans*. A. Adult. B. Newly hatched larva (dorsal view). C. Adult larva (dorsal view). D. Egg. E. Head (left lateral view). F. Head (dorsal view). G. Head (ventral view). H. Right mesothoracic leg. I. Left mandible (dorsal view). J. Right mandible (dorsal view). K. Epipharynx. L. Labium (ventral view). M. Left maxilla (dorsal view). N. Labium (ventral view). O. Left maxilla (ventral view). P. Left mesothoracic spiracle. Q. Pupa (ventral view). R. Pupa (left lateral view). S. Dorsal integument showing tubercles and hair (highly magnified).



few superficial rugae and minute reticulation between rugae; anteriorly bilobed due to presence of short medial cleft; lateral margins sinuate just behind cleft. Labrum with four strong setae on each side of which posterior one is situated on small, lateral, triangular sclerotized area in front of clypeal border; tiny seta also present on each side of labral cleft. Clypeus more or less rugoso-reticulate, about as long as, or slightly longer than, labrum; trapezoidal and bearing transverse row of about six setae behind anterior margin.

*Epipharynx* (Fig. 15K). Bilobed in front, anterior and lateral margins sclerotized, each lobe in front with rounded denticles, as well as triangular tooth (Dorsey's (1940) rectangular tooth), lateral margins each with short spine situated in line with second porous area. Median area concave, forming more or less a lobe on each side, bearing an oval area beset with spiculi; the two quinqueporous areas clearly indicated in most specimens with anterior parabolic row of fine pores. First porous area visible as two small circles just behind triangular teeth. Anterior to each spiculum-bearing area and just behind anterior lobes in line with first porous area is a small transverse area with fine setae.

*Mandibles* (Fig. 15I-J)

Slightly shorter than cranium, fairly narrow, with broad subtriangular base and nearly twice as long as width at base. Each mandible with an oblique, transverse dorsal depression separating cutting edge from base. Molar areas absent, cutting edge on each side comprised of two rounded teeth of which apical one is largest. Dorsal carinae absent; mandibles rounded on lateral face, each with single seta.

*Maxillae* (Fig. 15M, O)

Elongate, mala and stipes fused, lacinia and galea free only at extreme apex; latter with tuft of very fine hairs. Lacinia with eight to nine broad palus-like spines giving it a comb-like oblique anterior margin; mesal area of lacinia with some minute denticles at base. Maxilla dorsally without setae, ventrally with about five, of which one is situated half-way between galea and palpifer and one just below palpifer. Cardo somewhat oval, with Y-shaped suture (arms of Y pointing posteriorly) and with only one seta laterally on apex. Maxillary palpus appearing four-segmented, with apical segment the longest; third segment shorter than the second; first segment very small and with single seta ventrally; both apical and penultimate segments with setae. In his study of six American species, Dorsey (1940) gives the number of palpal segments as three.

*Labium* (Fig. 15L, N)

Different sclerites fairly easily recognizable; postmentum large and triangular or trapezoidal, usually bearing four setae near anterior margin. Mentum small and less sclerotized. Prementum large, consisting of basal sclerite, ventrally with four setae of which two are situated on its anterior, less sclerotized half. Apical sclerite with two-segmented palpi; this sclerite ventrally also with four setae.

*Hypopharynx* (Fig. 15N). Glosa deeply cleft in the middle, the two lobes densely covered with fine hairs; hypopharyngeal scleromes (= paraglossae, Böving & Craighead 1931) distinct; hypopharyngeal bracon well developed and symmetrical. Superlinguae united as one broad structure.

*Pupa* (Fig. 15Q–R)

Exarate, clearly showing broad pronotum of the adult. Anterior margin of pronotum with four long setae and some smaller hairs on disc; small hairs also present on posterior part of head. Abdominal segments each with long lateral setae; apex of abdomen with two strong setae or styli. Developing genital capsule visible as broad lobe between caudal styli. Anterior border of metathorax ventrally with two fleshy spines. Only first four pairs of abdominal spiracles large and clearly visible. Length 11–12 mm.

Newly formed pupae are almost pure white with golden brown hairs; as they develop they become darker, and just before emergence of beetles they are piceous.

BIOLOGY

Beetles were collected during midsummer and midwinter and usually appear wherever carcasses and skins are found. They feed on the latter or on other arthropods present, particularly on fly and blow-fly larvae. They are attracted to fish-meal in large numbers and eggs were often found during January and February in soil containing this medium.

Most of the eggs (Fig. 15D) collected in Claremont, Cape Town, vary from 2,20 by 1,4 mm to 2,4 by 1,6 mm and are oval, yellowish white and almost smooth and shiny. Most eggs were laid singly in the upper few millimetres of soil that contained fish-meal and hatched after 2–3 days during January. Shortly before hatching, two narrow dark lines separated by a thin pale line are visible near the anterior pole of the egg.

Newly hatched larvae (Fig. 15B) are similar to the mature larvae except in colour and size, and are almost pure white with reddish eyes, golden-coloured setae, and two dark or piceous parallel lines on the pronotum (already visible through the chorion in the embryo). These two black lines are visible only in the newly hatched specimens; after the first moult the lines disappear. The newly hatched larvae measure 4–4,2 mm in length and within 2–3 hours they turn to almost pitch black, with reddish eyes. In the laboratory the first instar lasted for about a day. After each moult the larvae are nearly white; second and third instar larvae usually assume their black colour after 2–4 hours, as in the first instar.

The second moult occurs 2–5 days after the first and the larvae then measure 9–10 mm. Within 3–4 days after the second moult they are 13–14 mm long and usually enter the soil, where they construct thin-walled clay cells in which they remain dormant for another 3–4 days before pupation occurs. The total lifespan of the third instar larvae varies from 6 to almost 8 days and the pupal

stages also last for 6–7 days, the adult beetles emerging 17–24 days after oviposition.

Newly emerged beetles are almost white with yellowish-brown pro- and mesonotum; the head is darker and the eyes dark brown; the last abdominal segment, legs, and antennae are pale yellowish brown. After a day or so they assume their normal dark coloration.

### *Silpha punctulata* Olivier

#### DESCRIPTION

##### *Adult*

Dull, brownish black, about 19 mm long, somewhat more oval in outline than *S. micans*, the elytra covering the abdomen. Head and prothorax fairly densely punctate, the punctures coarser on the lateral areas of pronotum than on its disc. The six elytral rugae very prominent, areas between them punctate, the punctures coarser than on pronotum. Legs microscopically reticulate-punctate or rugulose, tibiae spined as in *S. micans*. Antennal club not very prominent, the three segments clearly demarcated by presence of fine, short hairs causing pruinescence, rest of antennae slightly shiny as in the other species. It differs from *S. micans* by absence of hairs on dorsal surface of pronotum and elytra.

This species is widespread in the Subsaharan region (Jeannel & Hatch 1928); collection records also come from the western Cape Province.

##### *Larva* (Fig. 16A)

When mature about 25 mm long and brownish black in colour. Very similar to that of *S. micans*, but somewhat more elongate; abdominal terga lobe-like on each side, these lobes acuminate or pointed posteriorly. Meso- and metathoracic segments with posterior angles less acute than those of abdomen; prothoracic angles rounded; all posterior angles of body segments each with a short spine-like seta; anterior angles, except those of pronotum, each with three to four short setae. Ecdysial suture fairly distinct in most segments except probably last three or four. Urogomphi shorter in relation to body length than in *S. micans*, appearing two-segmented, with second segment also subdivided in most specimens examined and the setation similar to that of the latter species.

Legs similar to those of *S. micans* with somewhat more spine-like setae present on both femur and tibia. Body integument (Fig. 16C) dorsally covered with short scale-like setae forming a single row along posterior border of segments, except that of abdominal segment nine, which is without such a row. Setae on posterior border of tenth segment longer and spine-like. The integument differs from that of *S. micans* by the distinct reticulation and by the smaller and less obvious tubercles that are present; apices of scale-like setae entire, not cleft. Spiracles similar to those of the latter species, but lacking the two setae on internal side of the mesothoracic pair.



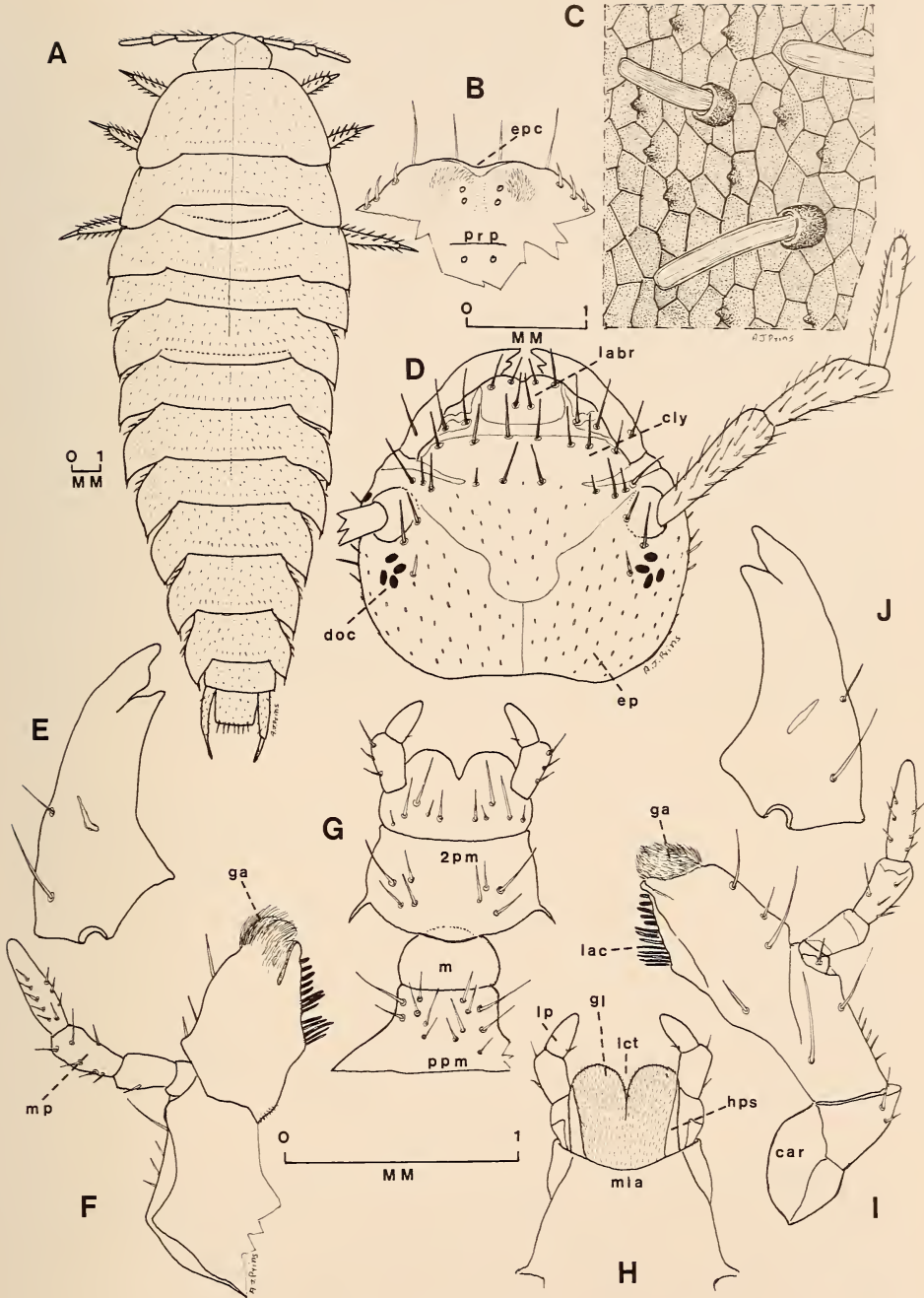


Fig. 16. Family Silphidae.

*Silpha punctulata*. A. Adult larva (dorsal view). B. Epipharynx. C. Dorsal integument showing tubercles and hair (highly magnified). D. Head (dorsal view). E. Left mandible (dorsal view). F. Left maxilla (dorsal view). G. Labium (ventral view). H. Labium (dorsal view). I. Left maxilla (ventral view). J. Right mandible (dorsal view).

In small larvae measuring about 10,5 mm long that were collected during January, all the antennal segments are about of equal length. In most of the specimens examined there are only about six long setae on the sternal plate just behind the head (about twenty-four in the mature specimens) and there is an extra-long seta on each lateral margin of the central disc of the labrum. There are also only two long setae ventrally on apical segment of labium, the other setae present are short and almost spine-like. Otherwise exactly as in the mature larva.

*Head capsule* (Fig. 16D)

Dark brown to blackish brown, about as long as wide or only slightly wider than long; minutely, or rather microscopically, reticulate-punctate and somewhat shagreened: cranial chaetotaxy as illustrated, similar to that of *S. micans* but differing from it by presence of short scale-like setae and absence of long setae on dorsal surface of epicranium, except two long setae in front of the four dorsal ocelli just behind antennal base, and one short spine-like seta dorsolaterad of median ocellus. Antenna three-segmented, first segment slightly longer than third (of about equal length in *S. micans*); second segment about as long as apical one (as in the case of the latter species) and without a conical projection. All segments with setae (in *S. micans* the first segment is without hairs).

Ventral side of head similar to that of *S. micans*, including two ventral ocelli, but postmentum with more setae.

*Labrum and clypeus* (Fig. 16D)

Labrum and clypeus united as in *S. micans* and similar in shape; labrum fairly deeply emarginate on anterior border, lateral margins sinuate behind cleft; dorsal surface with ten long setae, of which two are situated on each side on the sclerotized triangle, just in front of clypeal border. There is no demarcation line between clypeus and frons, except the sulcus on each side as in other species.

*Epipharynx* (Fig. 16B). Rather similar to that of *S. micans*; however, triangular teeth at apex are absent. Oval area with fine hairs present just behind anterior margin on each side of median concavity. Lateral margins with three short almost sickle-shaped setae (absent in *S. micans*) and denticles present on anterior margin of the latter species absent in this case.

*Mandibles* (Fig. 16E, J)

Slightly shorter than cranium, fairly narrow and more elongate than in *S. micans* due to narrow bases. As in latter species, a fairly prominent oblique depression present on each mandible separating cutting edge from base. Lateral faces fairly rounded, each mandible with two setae of which proximal one is longest. Two teeth of cutting edge distinct, apical one usually bilobed and larger than the other.

*Maxillae* (Fig. 16F, I)

Similar to those of *S. micans*, but in this species the lacinia and galea entirely fused, the demarcation line still visible, particularly on dorsal side. Galea forming a lobe with fine golden setae as in latter species; lacinia with twelve to thirteen palus-like spines, of which distal five are shorter with rounded apices, the other eight or nine longer. Mesal area of lacinia also with minute spines at base. Maxilla dorsally without setae, ventrally with about six setae as indicated in Figure 16I; exterior margin below palp with five short setae. Cardo as in *S. micans*, but with one long and one short seta near apex.

Maxillary palpi four-segmented as in *S. micans*, first segment small with one ventral seta, third segment longer than second (shorter than second in *S. micans*), apical one the longest. Both apical and penultimate segments with setae, second with only a single dorsolateral seta.

*Labium* (Fig. 16G-H)

Also similar to that of *S. micans*, postmentum triangular with about fourteen setae. Mentum smaller, less sclerotized and without setae. Prementum large and with about four setae ventrally on each side of its median area. Apical sclerite ventrally with about ten setae and with two-segmented palpi of which basal segment is slightly longer than apical one and bearing about four setae on exterior margin; apical segment with only a single short seta on its mesal margin in most specimens examined. Glossa deeply cleft in middle, the two lobes densely covered dorsally with fine hairs; hypopharyngeal sclerites clearly demarcated.

## BIOLOGY

Nothing is known about the life history of these beetles. Larvae were observed wandering about on the ground covered with fynbos.

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## REFERENCES

- ARNETT, R. H. 1963. *The beetles of the United States*. Washington: Catholic University of America Press.
- ARROW, G. J. 1909. Systematic notes on Coleoptera of the clavicorn families. *Ann. Mag. nat. Hist.* (8) 4: 190-196.
- BACKLUND, H. O. 1945. Wrack fauna of Sweden and Finland. Ecology and chorology. *Opusc. ent.* 5: 1-236.
- BERNHAEUER, M. & SCHUBERT, K. 1914. Staphylinidae IV. *Coleoptm Cat.* 57: 289-408.
- BORNEMISSZA, G. F. 1968. Studies on the histereid beetle *Pachylister chinensis* in Fiji, and its possible value in control of buffalo-fly in Australia. *Aust. J. Zool.* 16: 673-688.



- BÖVING, A. G. & CRAIGHEAD, F. C. 1931. An illustrated synopsis of the principal larval forms of the order Coleoptera. *Entomologica am.* **11**: 1–351.
- BÖVING, A. G. & HENRIKSEN, K. L. 1938. The developmental stages of the Danish Hydrophilidae. *Vidensk. Meddr. dansk naturh. Foren.* **102**: 27–162.
- DORSEY, C. K. 1940. A comparative study of the larvae of six subspecies of *Silpha* (Coleoptera: Silphidae). *Ann. ent. Soc. Am.* **33**: 120–139.
- EMDEN, F. I. VAN. 1942. A key to the genera of larval Carabidae (Col.). *Trans. R. ent. Soc. Lond.* **92**: 1–99.
- HAFEZ, M. 1939a. The life history of *Philonthus quisquiliarius* Gyllh. *Bull. Soc. ent. Egypt* **23**: 302–311.
- HAFEZ, M. 1939b. The life history of *Sphaeridium scarabaeoides* L. *Bull. Soc. ent. Egypt* **23**: 312–318.
- HAFEZ, M. 1939c. The external morphology of the full-grown larva of *Oxytelus latiusculus* Kr. *Bull. Soc. ent. Egypt* **23**: 333–338.
- HAFEZ, M. 1939d. The external morphology of the full-grown larva of *Cercyon quisquilius* L. *Bull. Soc. ent. Egypt* **23**: 339–343.
- HINTON, H. E. 1945. *A monograph of the beetles associated with stored products 1*. London: The Trustees, British Museum (Nat. Hist.); Norwich: Jarrold & Sons.
- JEANNEL, R. & HATCH, M. H. 1928. Silphidae. *Coleoptm Cat.* **95**: 63–244.
- KASULE, F. K. 1968. The larval characters of some subfamilies of British Staphylinidae (Coleoptera) with keys to known genera. *Trans. R. ent. Soc. Lond.* **120**: 115–138.
- KAUFMANN, R. R. U. 1937. Investigations on beetles associated with carrion in pannal ash near Harrogate III. *Entomologist's mon. Mag.* **73**: 268–272.
- KNISCH, A. 1924a. Neue Afrikanische Palpicornier. *Wien. ent. Ztg* **41**: 17–24.
- KNISCH, A. 1924b. Hydrophilidae. *Coleoptm Cat.* **79**: 1–306.
- MORLEY, C. 1907. Ten years' work among vertebrate carrion. *Entomologist's mon. Mag.* **43**: 45–51.
- NUORTEVA, P. 1970. Histerid beetles as predators of blowflies (Diptera, Calliphoridae) in Finland. *Annl. zool. fenn.* **7**: 195–198.
- PÉRINGUEY, L. 1896. Descriptive catalogue of the Coleoptera of South Africa. *Trans. S. Afr. phil. Soc.* **7**: 99–623.
- PESCOTT, R. T. M. & MILLER, L. W. 1937. Codlingmoth and William pears. Control methods investigated. *J. Dep. Agric. Vict.* **36**: 479.
- RICHMOND, E. A. 1920. Article 1. Studies on the biology of the aquatic Hydrophilidae. *Bull. Am. Mus. nat. Hist.* **42**: 1–94.
- SCHEERPELTZ, O. 1973. Coleoptera: Staphylinidae. *S. Afr. anim. Life* **15**: 43–394.
- THÉRON, J. 1956. Histeridae. *S. Afr. anim. Life* **3**: 295–303.

## ABBREVIATIONS

acc	acrocerci
adn	adnasale
ant	antenna
bt	teeth on base of labium
car	cardo
carc	carina (see also ck)
ce	cercus (see also ur)
ck	cervical keel (see also carc)
cly	clypeus
col	collum
c & st	cardo and stipes
doc	dorsal ocelli
dta	dorsal spot of distal tentorial arms
ep	epicranium
epc	epipharyngeal cleft

f	frons
fa	finger-shaped air-tube of biforous spiracle
fe	femur
g	developing genital capsule
ga	galea
gl	glossa
gs	gular suture
gu	gula
hb	hypopharyngeal bracon
hps	hypopharyngeal sclerome
hy	hypostomal margin
il	inner lobe
jx	juxta
l	ligula
lab	labium
labr	labrum
lac	lacinia
lct	ligular cleft
lm	prosthema
lp	labial palp
ls	labial stipes
m	mentum
m <sub>1</sub> , m <sub>2</sub>	molar area
ma	mala
mcc	mesocercus
mel	mesothoracic leg
ml	median lobe
m <sub>la</sub>	superlinguae/maxillulae
mp	maxillary palp
mx	maxilla
mxs	maxillary articulating area
n	neck
na	nasale
oc	ocellus
of	occipital foramen
ol	outer lobe
par	parietalia
pcc	procercus
pen	penicillus
pf	palpifer
pfg	palpiger
pg	pregula
pm (1 pm, 2 pm)	prementum
1 ppa	first porous area
2 ppa	second porous area
ppm	postmentum
pre	preartis
prp	parabolic row of pores
prvt	praeventrite
pvt	postventrite
qppa	quinque porous area
ret	retinaculum
rs	triangular tooth
sj	sensory appendix
sm	submentum
spir	spiracle
st	maxillary stipes
t	tarsungulus

t <sub>1</sub> -t <sub>3</sub>	scissorial teeth
ta	tarsus and claw
tb	tibia
tpp	tentorial pit
tr	trochanter
ur	urogomphus (see also ce)
voc	ventral ocellus
vt	ventrite